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VOL. V WASHINGTON, D. C., NOVEMBER-DECEMBER, 1924 No. 27

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THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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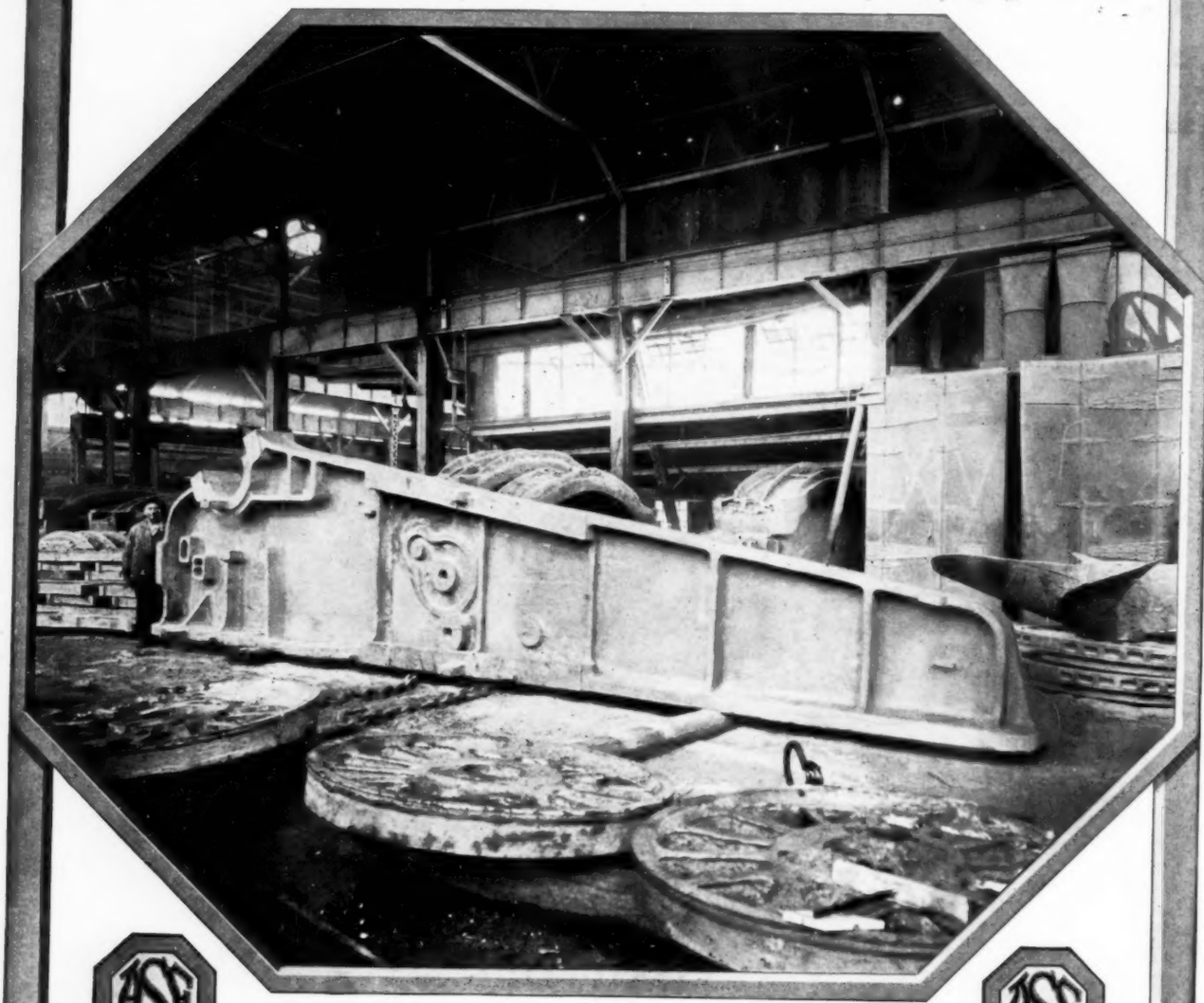

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ARMY AND NAVY REQUIREMENTS

NEW YORK CHICAGO ST. LOUIS

ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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WILLIAM W. COLEMAN, *Vice-President*

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VOL. V — NOVEMBER-DECEMBER, 1924 — No. 27

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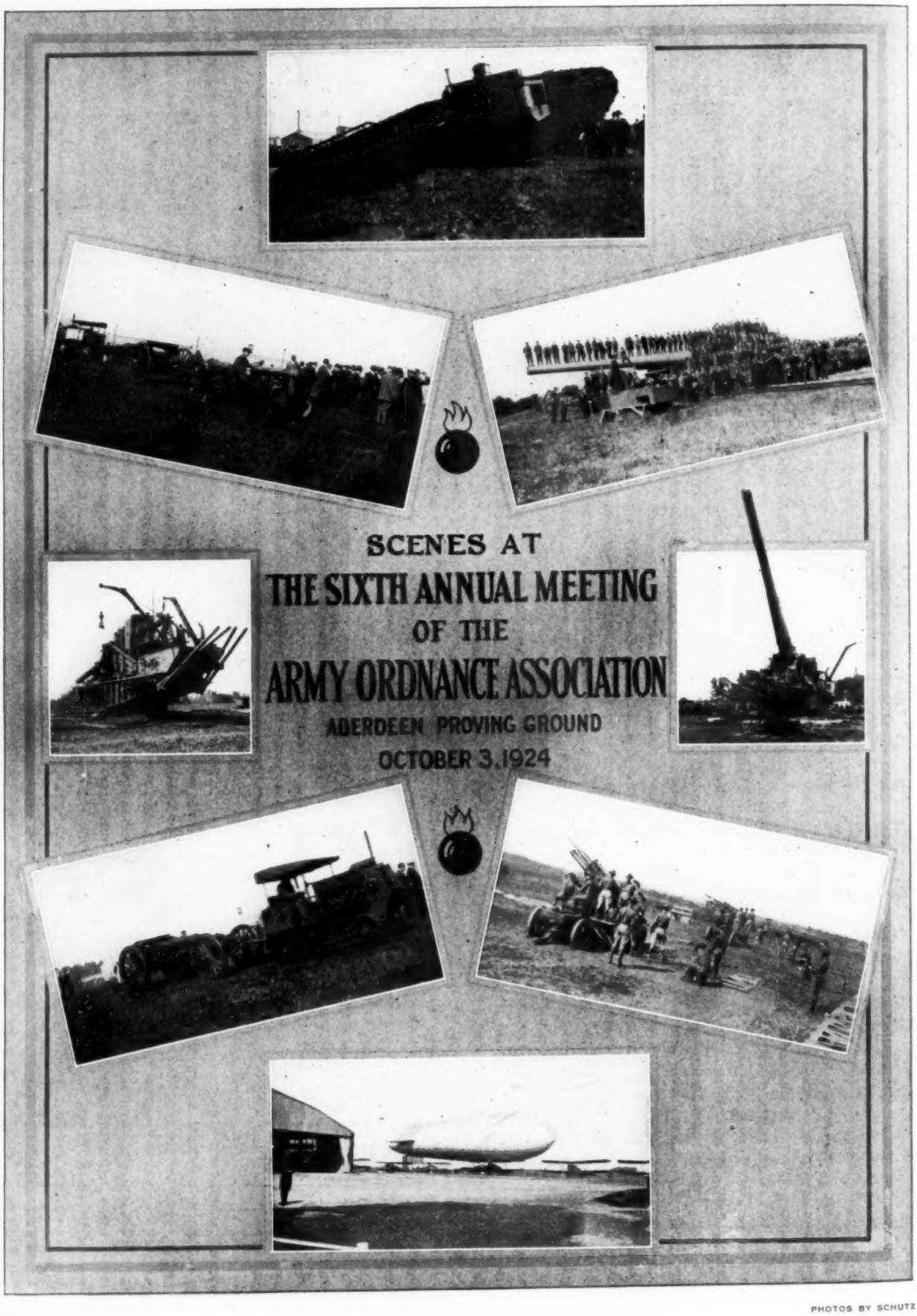


PHOTOS BY SCHUTZ

Chemistry of Ordnance Displayed

at the

Sixth Annual Meeting, A. O. A.

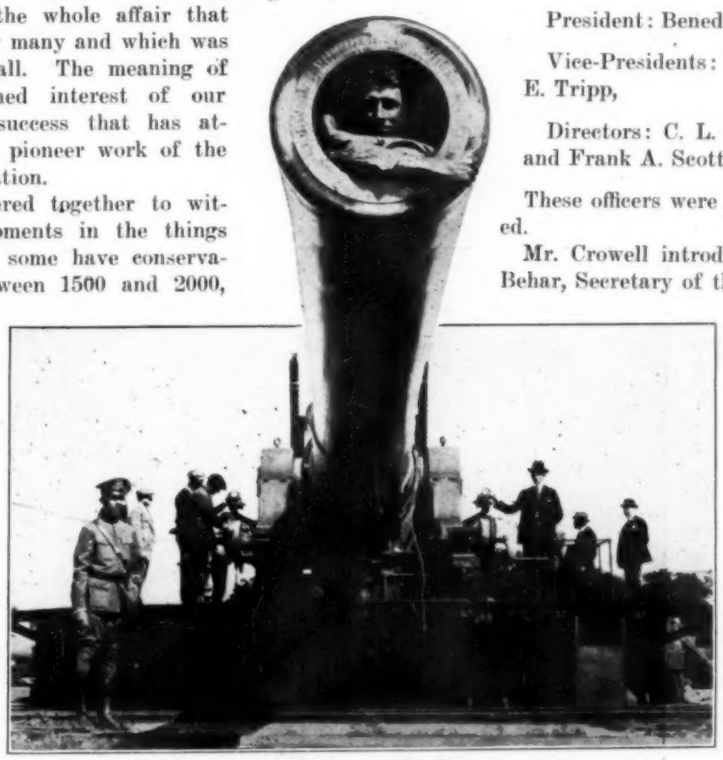
At Aberdeen

THE Sixth Annual Meeting of the Army Ordnance Association—devoted for the most part to the chemistry of Ordnance—was held at the Aberdeen Proving Ground, Friday, October 3, 1924, with one of the largest gatherings of members and guests in attendance.

With each passing year the annual meetings of the Army Ordnance Association have been described in the chronicles of the affair which appear in these pages as "the biggest," "the best," "the most interesting" and similar descriptive words indicative of a very successful and entertaining function. The same can certainly be said again this year! The meeting was largely attended—probably greater numbers were present than at any previous meeting. The demonstrations were given without a hitch, the weather was ideal, the bill-of-fare good, the get-together spirit everywhere present and the meeting as a whole a tremendous success. In addition to large numbers from the A. O. A., the meeting was participated in by goodly numbers from The American Institute of Chemical Engineers, The Institute of Makers of Explosives, The National Defense Section, A. S. M. E., and by local sections of the American Chemical Society. The occasion emphasized the chemistry of Ordnance. A truly important occurence in the annals of national defense! But above and beyond these physical features of the Sixth Annual Meeting there was a significance to the whole affair that was commented upon by many and which was obviously apparent to all. The meaning of the thing, the awakened interest of our citizenry, the evident success that has attended the six years of pioneer work of the Army Ordnance Association.

For here were gathered together to witness the latest developments in the things of war a group, which some have conservatively estimated at between 1500 and 2000, cognizant of the importance of adequate munitions preparedness which they manifested by attending a demonstration of ordnance that they might see and know for themselves the state of the union in this vital respect.

This interest and spirit of cooperation reached its zenith at the business meeting of the Association held in the late afternoon. Presided over by Honorable Benedict Crowell, President of the Army Ordnance Association and former Assistant Secretary of War, the gathering resolved itself into an expression of approval of the great work of the Ordnance Department and of proffers of cooperation on the part of the representatives of the several national organizations whose officers were in attendance and who had been invited to participate in the meeting.



16-inch Gun at Aberdeen

The meeting was opened by Mr. Crowell who welcomed the members of the visiting societies and gave a résumé of the work of the Association during the past year. He spoke of the Year Book for 1920 recently issued to members and of the new military medal of the A. O. A. and of the plans for furthering the interests of the Association in the future.

The Secretary's report was presented by Major R. H. Somers, who gave in detail figures concerning the finances and membership, citing with respect to the latter a gain of over 400 members for the past year.

Major C. G. Mettler, who served as chairman of the board of tellers appointed to canvass the ballots cast in the recent election of officers, announced that the following received a majority of the votes cast for the respective offices:

President: Benedict Crowell,

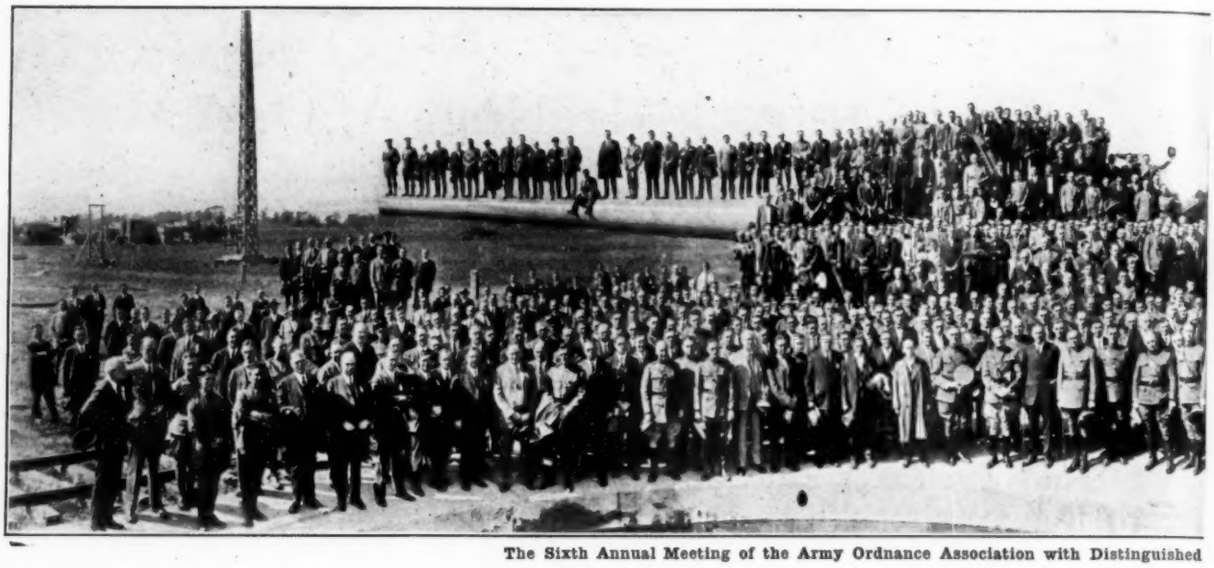
Vice-Presidents: W. W. Coleman and Guy E. Tripp,

Directors: C. L. Harrison, R. P. Lamont and Frank A. Scott.

These officers were then duly declared elected.

Mr. Crowell introduced Captain Manoel F. Behar, Secretary of the National Defense Section of the American Society of Mechanical Engineers. Captain Behar said in part:

"Mr. Crowell, gentlemen of the Army Ordnance Association, including many members of the A. S. M. E. The same causes that have lead to the creation of the A. O. A. led to the creation of the Ordnance Section of the A. S. M. E. four years ago. Several months ago the scope of the Ordnance Section of



The Sixth Annual Meeting of the Army Ordnance Association with Distinguished

the A. S. M. E. was extended and it is now known as the National Defense Section of the Society. We mechanical engineers feel that Ordnance will continue to remain the major interest of our work, but in order to place at the disposal of the authorities the full extent of the talent which may be furnished and we hope *will* be furnished by our 17,000 engineers throughout this country and the world, I might say, the scope was enlarged and we now maintain contacts with the divisional branches of the Army and Navy. Through having on the Executive Committee of our National Defense Section the Assistant Secretary of War, Quartermaster General, Chief of Ordnance, Chiefs of Coast Artillery, Air Service, Chemical Warfare, Assistant Secretary of the Navy, Chief of Naval Operations, Chiefs of Bureaus of Yards and Docks, Ordnance, etc., we have this contact.

Being a young organization the National Defense Section of the A. S. M. E. cannot report as yet much progress along their own lines suggested with these contacts with official bureaus at Washington. It will be of interest to the members of the A. O. A. to be informed that not only does Ordnance make up the major interest of the activities of the National Defense Section of the A. S. M. E. but that the papers to be read at the National Defense Section at their annual meeting in December will be on ordnance.

I have the pleasure to extend to the officers of the A. O. A. the greetings of the President of the National Defense Section, Mr. Lowe, the Chairman Major Miller, Vice-Chairman Colonel Sherwood and General Secretary Major Calvin W. Rice."

Mr. Crowell thanked Captain Behar on behalf of the Association and its officers for his cordial message. He then announced that a short time would be given over to informal talks on the future of chemistry in warfare, and called upon General Williams, Chief of Ordnance, to say a few words.

General Williams: "I first would like to express the appreciation of the Ordnance Department for the interest which the members of the Army Ordnance Association and our friends have taken in our work and in the problems that we have before us. Of course, we are intimately interested in chemistry because it touches very closely so many of our problems. I am not myself a chemist and cannot discuss these questions from a chemical viewpoint. The only thing that I claim to have is an appreciation of the value of chemistry to us and of the necessity for cooperation with the chemists of the country and the chemical manufacturers, and Mr. Chairman, I think the time of the meeting could much better be taken up if some of the prominent chemists who are present would give us their views."

6-ton Tank Laying Down Smoke Screen at the Aberdeen Meeting

Mr. Crowell: "We have, through the courtesy of the Chemical Warfare Service, had a considerable display of their developments today. General Fries, Chief of the Chemical Warfare Service, is with us and I am going to ask him to speak to you.

General Fries: "Mr. President and gentlemen. It may be true that the Chief of Ordnance is not a chemist, but I do know that he and his department have shown great appreciation of the part chemistry has played and will play. The more we study chemistry, the more we realize the dependence on it of the manufacture of ordnance." General Fries

Guests and Visitors at Aberdeen Proving Ground, Maryland, October 3, 1924

then went on to say that it had been a great pleasure to work with the Ordnance Department always and that he had had complete cooperation from General Williams and his Department. He emphasized that while finances of the C. W. S. had been very limited since the World War, the work had gone on although the science of chemistry in this respect had yet hardly been touched.

Mr. Crowell: "It is a pleasure to see back here today Dr. Parsons, Secretary of the American Chemical Society, and I am going to ask him to tell us what he thinks of the future of chemistry in warfare."

Doctor Parsons expressed the fact that he had a very warm spot in his heart for the Ordnance Department with which he was associated in 1916. He went on to tell of his experiences abroad during eight months of the war and his connection with fixed nitrogen work. In his remarks he stressed the willingness of the American Chemical Society to be of service to the Ordnance Department as also to the Chemical Warfare Service.

Mr. Crowell: "The one company that I believe is most important to the Army in time of war is the DuPont Company and I am going to ask Col. Spruance, Vice-President of that company, to address us."

Colonel Spruance: "I do not know that I can contribute any remarks to this discourse along the lines of chemical warfare except to say that the DuPont Company does some work along that line and it is intensely interested in, and we have tried to maintain, as conditions have changed, the contact which has become more general than when the department has simply dealt with powder and explosives. There are many interesting problems in this connection and, from an engineering standpoint, I would like to speak just a minute on the history of the Army Ordnance Association as a case in point. I happen to be one of the charter members and a member of the Founders Committee. When we talked over the question as to what the Association could do, it seemed that the object in peace time was to make the American people see that they had to move first and to show what they can do and how they want to be served, and we have been most impressed from 1920 to 1922 with the development which then started and which has since been reached. The Association is to be congratulated. It has made an effort to excite the interest of engineers and technical societies, and last year with the attendance of the American Iron and Steel Institute, we reached another important stage.

If I have any suggestion to make for future activities of the Association and for cooperation along chemical lines, it would be for all of us to go home and try to interest every one we know in the aims and objects of the Association and in the work which is demonstrated in such meetings as we have had today."

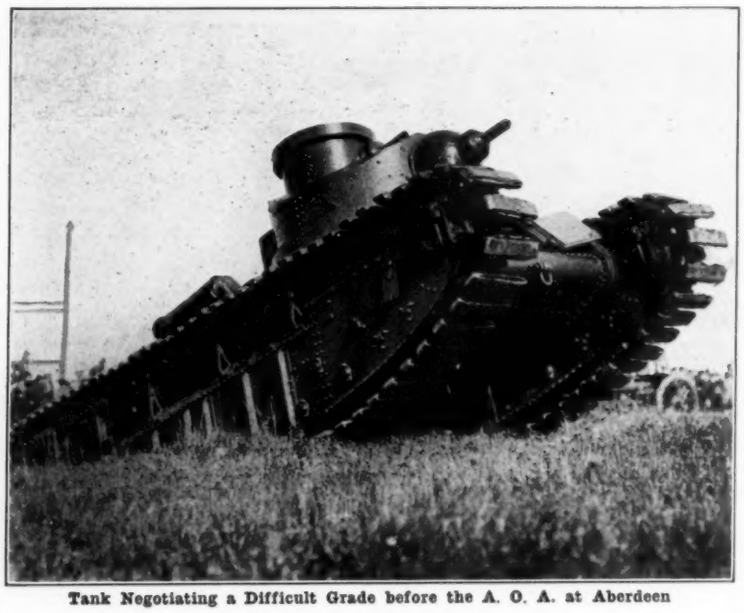
Members of A. O. A. on Familiar Terms with 16-inch Gun at Aberdeen

Mr. Crowell: "I am going to ask Mr. E. R. Grasselli of the Grasselli Chemical Co., to say a few words."

Mr. Grasselli: "I am much impressed with this meeting and I want to congratulate the Association on the demonstration given here today. Doctor Parsons has said all there is to say in connection with chemistry, and I thank you very much."

Mr. Crowell: "May I ask Doctor Burgess of the Bureau of Standards to give us his views?"

Dr. Burgess: "Mr. Chairman, gentlemen. This is also my first visit and I am very much impressed with the demonstration which was given today and I also think it is a splendid idea that you have, in holding these meetings, inviting different societies in the country who are interested in ordnance and things pertaining to it." Doctor Burgess then spoke of the work done by the Bureau of Standards, its importance in connection with ordnance, etc. He thought it very wise, he said, that the Bureau should continue its work during peace-time the same as during war, and that the question of available material for military purposes should be kept in mind. He suggested that the American Society for Steel Treating would be very much interested in the annual meeting and that they be invited to participate. He completed his talk with thanks for the opportunity given him of being present at the meeting.



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Next two 600-pound demolition bombs, Mark I, were dropped from a Martin Bomber for water impact from an altitude of 2,000 feet. Each bomb contained about 300 pounds of TNT. The first was equipped with an instantaneous fuze, the second with a fuze giving 1.2 seconds delay. The variation in time was readily distinguishable.

At 10:50 o'clock one round was fired from the 14-inch gun on railway mount, model of 1920. This huge piece is the latest type of railway mount designed for seacoast defense and is probably the largest which will ever be constructed of this type. The mount can be fired either from a concrete emplacement or from standard gauge track using special out-riggers as supports. The maximum range of this piece is about 22½ miles. The projectile weighs 1560 pounds and a powder charge of 470 pounds is required. Exhibited near the gun were 14-inch armor plate and a 14-inch armor-piercing projectile recovered after passing through the plate.

At 11:10 one round was fired from the 16-inch gun mounted on Barbette carriage, Model of 1919, MII. This is the largest gun constructed for seacoast defense in America. The complete equipment consists of electric motors operating through speed gears for elevating, traversing and loading, and an electrically driven air-compressor for operating the breech-block and purging the bore. A rate of fire of one round per minute can be maintained with this equipment. The maximum range is over 31 miles, the projectile weighs 2,340 pounds and the powder charge weighs 850 pounds. This was one of the most spectacular events of the day.

Attention then turned to the Aviation Field, where were exhibited the various types of American and foreign bombs including the fragmentation, chemical, demolition and armor-piercing types. Also were shown the various models of airplanes and bombers as well as the non-rigid dirigible TC2, which maneuvered about the reservation. Less than a week after this performance this giant ship, while flying over Langley field, Va., was wrecked causing the death of Lieutenant Bruce N. Martin, pilot, and the injury of Lieutenant Puryear and Sergeants Fitch, Wells and Jensen, all members of the crew. The TC2 was the largest non-rigid airship ever built in the United States. She had a length of 196 feet and an over-all height of 59 feet. Constructed for training purposes the car was of an improved pattern, 40 feet in length with two 150-horsepower motors aft. She had a speed of 60 miles per hour and an endurance capacity of 10 hours in the air at that rate.

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After luncheon at the Visitors House, the guests were taken to the Main Front where a series of spectacular events took place. First were brought out and maneuvered the various kinds and types of automotive matériel developed by the Ordnance Department. These included:

Tanks

Mark VIII Tank with Stroboscope

This tank was designed during the World War by joint British and American commission for use against the trench system of the Hindenburg Line. One hundred of these tanks were completed after the war. The main characteristics are: Weight, 40 tons; maximum speed, 6 miles per hour; armor, ⅝-inch; motive power, 12-cylinder Liberty engine; armament, two 6-pdr. and five machine guns; crew, 1 officer and 11 men.

6-Ton Tank Equipped with Smoke Screen Device

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Medium Tank, Model 1921

This is a post-war development, intermediate in weight between the 6-ton and Mark VIII tanks. Maximum speed, 12 miles per hour; armor protection against .50 caliber armor-piercing ammunition; armament, one 6-pdr. (2.24-inch) gun and two machine guns; spring suspension; engine, Murray and Tregurtha 6-cylinder.

Christie Tank

This is a post-war development designed to demonstrate the principle of combining in one vehicle means for traveling across country on tracks and upon good roads on wheels. Designed and manufactured for the Ordnance Department by Walter Christie.

Tractors

2½-Ton Model 1918 with Modified Cooling System

This vehicle represents the first attempt of the Ordnance Department to provide a special tractor for use with Divisional Artillery. Speed with Cadillac motor, 15 miles per hour. Means are provided in this vehicle for cooling the crank-case lubricant by its forced circulation through a radiator

2½-Ton Model 1918 with Liberty Truck Engine Towing 1½-Ton Trailer

The original design modified to cover the substitution of a Liberty truck engine for the Cadillac engine in the endeavor to secure increased dependability. The armor over the engine has been replaced by an ordinary truck hood.

5-Ton Artillery Tractor Towing 155-mm. Howitzer and Limber

The tractor now standard in the Army for the draft of Corps matériel. Practically identical with the 5-ton tractor manufactured and sold by the Holt Manufacturing Company. Weight of tractor, 10,000 pounds; speed, 7¼ miles per hour at governed engine speed.

10-Ton Artillery Tractor Towing 155-mm. G. P. F.

The tractor now standard in the Army for use in the draft of Army Artillery matériel. The same vehicle is marketed by the Holt Manufacturing Company. Maximum speed is 5.6 miles per hour at governed engine speed.

Fordson Tractor with Hadfield-Penfield Adapter Towing ¾-Ton Trailer

This is the standard commercial Fordson tractor, except for the replacement of the rear wheels by the track adapter. This equipment is under extensive test to determine its stability as a divisional tractor.

Fordson Tractor with Full Crawler Adapter Towing 75-mm. Gun

This tractor is now under test at the Proving Ground to determine its suitability for use as a divisional tractor.

Holt T-35 Towing Cargo Carts, Model 1923

This tractor is manufactured commercially by the Holt Manufacturing Company and is being extensively tested in the Army as a divisional tractor. As now equipped the tractor has a speed of approximately 10 miles per hour at an engine speed of 1000 r. p. m. The rubber padded track has given exceptionally good service.

Pavesi Tractor

This is a vehicle of Italian manufacture with the novel characteristics of four-wheel drive and four-wheel steer.

Pyrotechnic Display with which the Sixth Annual Meeting Closed

Topp-Stewart Tractor

An American commercial product incorporating four-wheel drive and four-wheel steer. This vehicle has been under test, together with the Italian Pavesi tractor, to compare the relative performance of wheel and track-laying tractors.

Motor Gun Carriages

75-mm. Gun Motor Carriage, Mark VII

Equipped with the Cadillac engine, this vehicle has a maximum speed of 15 miles per hour. The chassis is similar to that of the 2½-ton Tractor, Model 1918.

75-mm. Gun Carriage, Mark VI

This vehicle is designed to mount either the 75-mm. Gun or 105-mm. Howitzer, Model 1920, and with the motor with which equipped it has been possible to secure speed of 30 miles per hour on good roads. As originally designed the motor-carriage engine was water-proofed to permit running completely immersed, but this feature has now been dispensed with.

155-mm. Gun Motor Carriage, Model IX

This is a post-war development undertaken jointly by

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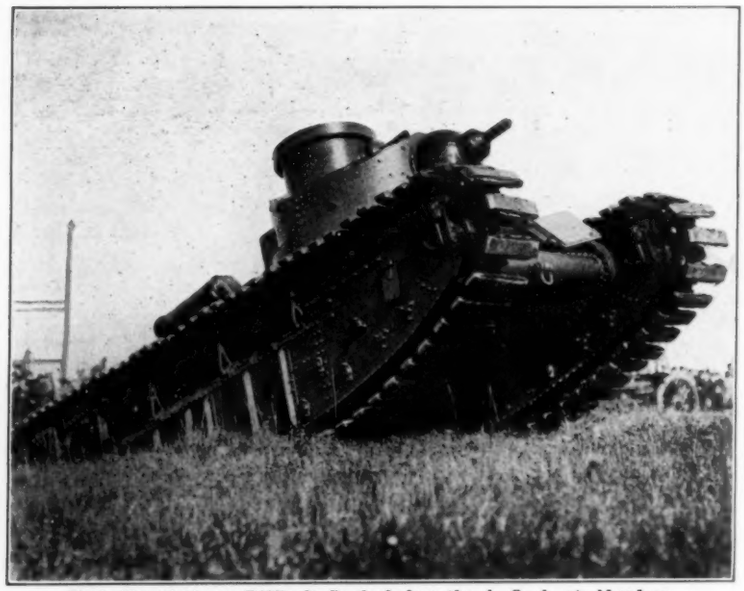

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This vehicle represents the first attempt of the Ordnance Department to provide a special tractor for use with Divisional Artillery. Speed with Cadillac motor, 15 miles per hour. Means are provided in this vehicle for cooling the crank-case lubricant by its forced circulation through a radiator

2½-Ton Model 1918 with Liberty Truck Engine Towing 1½-Ton Trailer

The original design modified to cover the substitution of a Liberty truck engine for the Cadillac engine in the endeavor to secure increased dependability. The armor over the engine has been replaced by an ordinary truck hood.

5-Ton Artillery Tractor Towing 155-mm. Howitzer and Limber

The tractor now standard in the Army for the draft of Corps matériel. Practically identical with the 5-ton tractor manufactured and sold by the Holt Manufacturing Company. Weight of tractor, 10,000 pounds; speed, 7¼ miles per hour at governed engine speed.

10-Ton Artillery Tractor Towing 155-mm. G. P. F.

The tractor now standard in the Army for use in the draft of Army Artillery matériel. The same vehicle is marketed by the Holt Manufacturing Company. Maximum speed is 5.6 miles per hour at governed engine speed.

Fordson Tractor with Hadfield-Penfield Adapter Towing ¾-Ton Trailer

This is the standard commercial Fordson tractor, except for the replacement of the rear wheels by the track adapter. This equipment is under extensive test to determine its stability as a divisional tractor.

Fordson Tractor with Full Crawler Adapter Towing 75-mm. Gun

This tractor is now under test at the Proving Ground to determine its suitability for use as a divisional tractor.

Holt T-35 Towing Cargo Carts, Model 1923

This tractor is manufactured commercially by the Holt Manufacturing Company and is being extensively tested in the Army as a divisional tractor. As now equipped the tractor has a speed of approximately 10 miles per hour at an engine speed of 1000 r. p. m. The rubber padded track has given exceptionally good service.

Pavesi Tractor

This is a vehicle of Italian manufacture with the novel characteristics of four-wheel drive and four-wheel steer.

Pyrotechnic Display with which the Sixth Annual Meeting Closed

Topp-Stewart Tractor

An American commercial product incorporating four-wheel drive and four-wheel steer. This vehicle has been under test, together with the Italian Pavesi tractor, to compare the relative performance of wheel and track-laying tractors.

Motor Gun Carriages

75-mm. Gun Motor Carriage, Mark VII

Equipped with the Cadillac engine, this vehicle has a maximum speed of 15 miles per hour. The chassis is similar to that of the 2½-ton Tractor, Model 1918.

75-mm. Gun Carriage, Mark VI

This vehicle is designed to mount either the 75-mm. Gun or 105-mm. Howitzer, Model 1920, and with the motor with which equipped it has been possible to secure speed of 30 miles per hour on good roads. As originally designed the motor-carriage engine was water-proofed to permit running completely immersed, but this feature has now been dispensed with.

155-mm. Gun Motor Carriage, Model IX

This is a post-war development undertaken jointly by

the Ordnance Department and the Holt Manufacturing Company. The carriage is designed to mount either a 155-mm. Gun or 8-inch Howitzer, Model 1921. A maximum speed of 14 miles per hour has been attained. The motor carriage is under test continuously at the Proving Ground.

4.7-inch Gun Motor Carriage, Model 1922 E

This vehicle has but recently been completed at the Rock Island Arsenal and is now undergoing test at the Proving Ground. It is now proposed to test this carriage as a corps tractor after the gun and top carriage have been removed.

240-mm. Howitzer Motor Carriage (St. Chammond) Mark IV and IV-A

These two units are identical in respect to main frames and tracks. The power unit is also used as the ammunition carrier, consisting of a cargo of 42 rounds of ammunition for the howitzer, and when so loaded the complete weight of this unit is 51,000 pounds. Both units are equipped with 70 h. p. motor drive to each individual track and the two vehicles may be operated independently within the limit of length of the connecting cable. The maximum speed of these two units is approximately 8 miles per hour.

CROSS-COUNTRY VEHICLES

Dodge Car

A standard Dodge chassis modified to reduce the weight as much as possible and equipped with full balloon tires. The cross-country mobility of this vehicle is greatly improved over that of a standard Dodge car.

Ford Car

In this modification of a standard Ford chassis the attempt has been to secure the best cross-country mobility possible. The car is equipped with full balloon tires and an auxiliary transmission providing greater gear reduction.

Dodge Car with Chase Track

A post-war development for improving the mobility of standard commercial automobile chassis for cross-country work. This represents practically the first attempt made in this class of development.

Mark VII Tractor Caisson, Modified

The Mark VII, tractor caisson of war-time development modified with respect to height of idler and drive sprocket to give a cross-country mobility comparable to that of tanks. This vehicle will be tested by the Tank Corps as a cargo carrier in the supply of tank units.

Cargo Cart, Model 1923

This vehicle consists of a 75-mm. Gun limber modified to replace the limber chest with a cargo body of approximately 40 cubit feet capacity. This type is now under test to determine its suitability as an ammunition and general cargo carrier towed by whatever divisional tractor that may be adopted in the service.

After this martial array, a Martin bomber took off and from an altitude of 4,000 feet dropped two 600-lb. demolition bombs for land impact. Both bombs were equipped with instantaneous fuzes which functioned perfectly. These were followed by the dropping of smoke bombs and the laying down of a smoke screen by a 6-ton tank equipped for that purpose. Chemical Warfare Troops demonstrated the use of smoke candles developed by that Service for preventing hostile observation of ground activities such as troop movement and concentration of tanks and artillery.

Then followed a unique demonstration by a battery of the 6th Field Artillery which maneuvered into position, put down a smoke barage using smoke shell and registered on a target with shrapnel. The operation was carried out in excellent order and met with the approval of all present.

Next followed firings of small arms which included: Cal. 30 Browning Machine Guns against free balloons; cal. 30 and cal. 50 armor-piercing bullets against tank armor; firings with white phosphorous rifle grenades and firings of ground type pyrotechnics.

Next came the mobile artillery demonstrations. These included firings of the following:

37-mm. Gun, Model 1916, Firing Super-sensitive Fuzes against Airplane Fabric

These fuzes have been developed for use against airplanes and are sufficiently sensitive to function against wing fabric.

75-mm Gun, Model 1920, on S. P. Mount, Mark VI

This is a post-war development of self propelled divisional artillery. This gun and recoil mechanism may also be mounted on the 75-mm. Carriage, Model 1920. The range of this weapon is 15,000 yards.

105-mm. Howitzer, Model 1920

This howitzer, together with the 75-mm. Gun, Model of 1920, are post-war developments of divisional artillery and are interchangeable on the 1920 carriage. The range of this weapon is about 12,000 yards with a 33-pound projectile.

4.7-inch Gun, Model 1921

This gun and mount are the latest development of the Ordnance Department for use as Corps Artillery, the corresponding howitzer being the 155-mm. Howitzer. The range of this piece, with a 50-lb. projectile, is 20,000 yards.

155-mm. Howitzer, Model 1920

This is a post-war development of Corps Artillery and is interchangeable with the 4.7-inch Gun on the 4.7-inch Gun—155-mm. Howitzer Carriage, Model 1920. The feature of interchangeability of Corps Artillery has been abandoned in the later developments of this type of artillery.

155-mm. Gun, Model 1920, on Self-Propelled Mount, Mark IX

A post-war development of the Ordnance Department intended to provide self-propelled mounts for Army artillery in addition to the regular type of wheel mount. The range of this weapon is 26,000 yards, firing a 105-pound projectile. This mount also takes the 8-inch Howitzer, Model 1920.

8-INCH HOWITZER, MODEL 1920

This Howitzer, together with the 155-mm. Gun, comprises the artillery now being developed for use as Army artillery.

4.7-INCH ANTIAIRCRAFT GUN, MODEL 1920

This is the largest caliber gun so far developed by the Ordnance Department for antiaircraft use. It is fitted with a muzzle brake by which means the forces operating on the carriage during recoil are reduced With a muzzle velocity of 2,600 f. s., this gun has a horizontal range of 20,000 yards (45-pound projectile).

75-MM., MODEL 1897, FIRING BLACK, SERVICE AND FLASHLESS POWDER

These rounds were fired for the purpose of showing the relative amounts of smoke produced by the above types of powder.

3.3-INCH STABILITY FIRING

Projectile design requires a knowledge of the forces acting upon various types of projectiles when fired in guns having different twists of rifling. These data are obtained by firing through cardboard screens and noting the location and form of hole made by the passage of the projectile. The range at the Proving Ground is constructed so that a section of the trajectory 1,000 feet in length may be determined.

75-MM., MODEL OF 1897. OUTLINE OF TRAJECTORY

The form of the trajectory with this gun was shown by firing a series of rounds of shrapnel with time fuzes set to function simultaneously. The fuzes were set at two second intervals.

The business meeting of the Association was held in the Administration Building at 5 o'clock. As already described this was well attended and enthusiastically participated in. After dinner, which was served in the Visitors' House at 6 o'clock, night firings were conducted at the Main Front. These were the most spectacular events of the whole day. Demonstrations were given of the .30 and .50 cal. tracer bullets; ground pyrotechnics, for use of ground troops as signals, and airplane flares and signals were also shown. Night tracers were fired from the 3-inch field gun.

A word must be said here for the remarkable exhibit of the Chelsea mechanical time fuzes which were fired from the 3-inch antiaircraft gun. The Chelsea Clock Company has developed a fuze of the mechanical type the performance of which met with the universal acclaim of all spectators. When it is recalled that this delicate mechanism fired from a powerful gun at 60° elevation, set at 30 seconds, functioned with remarkable precision, the applause of the onlookers was well warranted.

Then followed firings of the 75-mm. gun, model of 1897, showing the relative flash of service smokeless powder and the recently developed smokeless, flashless, non-hygroscopic powder. Here again a word is due the government experts and those of commercial producers who have co-operated in the development and perfection of this remarkable powder. A mammoth pyrotechnic display closed the program.

Thus came to a close the sixth, the best, the biggest and the most enthusiastic meeting of the Army Ordnance Association. That it was a worthy gathering of the members of the A. O. A. there can be no doubt; that it brought home to those who attended the great strides in Ordnance development being made by the Ordnance Department is generally conceded; that it emphasized the meaning and importance of industrial preparedness few will deny; that it augurs well for the future of our national defense and the security of our realm must be acknowledged by all.

Before closing this chronicle we wish to express publicly—as the officials of the Association have already done privately—the gratitude of the Army Ordnance Association to all those who contributed to this signal demonstration: To General Williams and his assistants for their co-operation; to the Commanding Officer at the Proving Ground and his associates for a program well arranged and perfectly executed; to the Chief of Chemical Warfare Service and the troops from Edgewood Arsenal for the exhibition of chemical warfare developments; to the Chief of Coast Artillery and the battery of the 61st Coast Artillery troops from Fort Monroe who conducted the antiaircraft firings; to the Chief of Air Service and the officers from Langley Field for their flying and bombing exhibits; to the Director of the Fixed Nitrogen Research Laboratory, Department of Agriculture, for the exhibit of the new process for synthetic ammonia production, and to the Commanding Officer of Picatinny Arsenal and his assistants for the exhibit of the various types and kinds of explosives.

Ordnance District Chiefs Discuss Procurement Plans

TWELVE of the fourteen chiefs of the Ordnance Procurement Districts assembled in Washington, October 1 and 2 to discuss with the officials of the Ordnance Office current matters concerning the ordnance procurement war plans. General Colden L'H. Ruggles, Chief of Manufacture of the Ordnance Department, presided at the meeting on October 2, when the following subjects were discussed: Ordnance contract forms, ammunition production studies, factory plans, new requirements, civilians qualified in munitions production, war industries board, relations of districts and arsenals, machine tool requirements, organization charts, and defense test. September 30 and October 1 a conference was held between the executive assistants with the chiefs of the Ordnance Office who have business with the several district organizations.

Following are the district chiefs and executive assistants who attended the meetings: Baltimore, Howard Bruce and Capt. H. S. Wilkins; Boston, Col. C. H. Tenney, O. R. C., and Capt. L. P. Crim; Birmingham, Col. John S. Sewell and Capt. C. H. Menger; Bridgeport, Col. B. A. Franklin, O. R. C., and Lieut. D. G. McGregor; Buffalo, Col. L. Cogswell, Jr., O. R. C., and Capt. R. E. Hardy; Chicago, E. A. Russell and Lieut. R. F. Melin; Cincinnati, Col. C. L. Harrison, O. R. C., and Lieut. C. E. Lex, Jr.; Detroit, Col. H. A. O'Dell, O. R. C., and Capt. C. Barnard; New York, Col. James L. Walsh, O. R. C., and Capt. H. W. Churchill; Philadelphia, J. C. Jones and Capt. W. E. Ditmars; Pittsburgh, R. M. Dravo and Lieut. J. A. Root; St. Louis, M. E. Singleton and Maj. Selby H. Frank.

Hon. Frank A. Scott

Recently Appointed Chief
Cleveland Ordnance District

Organizer and First Chairman
War Industries Board, 1917

President, Warner and Swasey Company
Cleveland

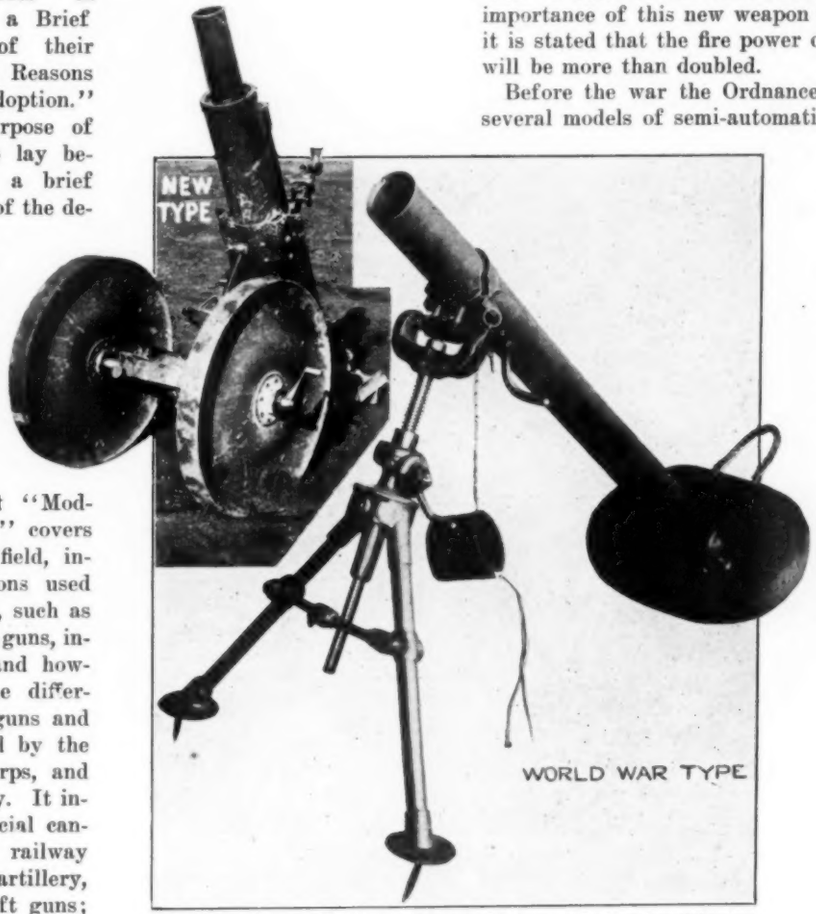
Modern Ordnance

By

MAJ. GEN. C. C. WILLIAMS, U. S. A.
Chief of Ordnance

The following discussion of the latest developments of American Ordnance was presented by General Williams before the Franklin Institute of Philadelphia September 19, 1924, and before the Philadelphia Forum, October 16, 1924

ON February 26, 1920, I had the pleasure of presenting a paper before the Mechanical Engineering Section of the Franklin Institute on the "Types of Artillery Equipment used by the American Expeditionary Forces in France with a Brief Description of their Uses and the Reasons for their Adoption." It is the purpose of this paper to lay before you in a brief manner some of the developments which have taken place in ordnance matériel in the period which has elapsed since the World War.



The Stokes Trench Mortar of the World War and the New Infantry Cannon Compared

The subject "Modern Ordnance" covers a very wide field, including weapons used by the soldier, such as rifles, machine guns, infantry guns and howitzers; all the different types of guns and howitzers used by the Divisional, Corps, and Army Artillery. It includes the special cannon, such as railway and seacoast artillery, and antiaircraft guns; ammunition, including bombs, fuzes, propellants, explosives and projectiles for all the different types of cannon; tanks, tractors and other special motor vehicles, and so on down the list of some one thousand items which are necessary for equipping the modern army. It will therefore be appreciated that, in the time available, it will only be possible to invite your attention to a few of the more important phases of the problems of Modern Ordnance.

Small Arms

Semi-Automatic Shoulder Arm

One would not expect very much change in the Springfield rifle, which, as is well known, has been a very satisfactory weapon. We feel it is the best in the world. However, there is an important development now in progress in the field of shoulder arms, which will have a very important effect on the arming of the infantry soldier. I refer to the semi-automatic shoulder rifle. The importance of this new weapon will be appreciated when it is stated that the fire power of the soldier so equipped will be more than doubled.

Before the war the Ordnance Department constructed several models of semi-automatic shoulder rifle, but they were all of a very complicated nature, heavy and unreliable in their functioning.

It is very difficult to produce an entirely satisfactory shoulder arm to meet the rigid requirements of the military service, especially since the weight must be kept practically the same as that of the present magazine rifle. During the World War a great deal of work was done along this line. Several models were made operating on different principles, but none was satisfactory. Since that time the experimental work has continued. Each year, with the exception of 1922, the specifications desired by the Ordnance Department for this type of weapon were sent to all the interested American designers, and competitive tests were held by the Springfield Armory by special boards convened by the War Department.

While a number of promising weapons have been tested and several have functioned quite satisfactorily, none has so far shown sufficient promise to warrant adoption as the standard type of semi-automatic rifle for the American Army. Judging from the progress which has already been made, we may be sure that American inventive genius will soon provide us with a highly developed and satisfactory semi-automatic shoulder arm.

50 Cal. Machine Gun

The second important small arm development is that

of the caliber 50 machine gun. This weapon is available for aircraft and antiaircraft use, with the possibility of future use in tanks, since its size permits us to use a very effective armor-piercing bullet for antitank use.

Its rate of fire is about 550 shots per minute.

37-mm. Automatic Gun

The 37-mm. hand-operated gun firing a 1.25-lb. projectile was very successfully used during the war by the Allies as an infantry weapon against machine guns, field fortifications and tanks, and also as an antiaircraft weapon. The value of this gun would, of course, be greatly enhanced for aircraft and antiaircraft purposes if it could be made to fire automatically. Several models of automatic aircraft cannon have been designed and built by private manufacturers and by the Ordnance Department since the war. A very satisfactory 37-mm. full automatic aircraft gun has recently been completed by Mr. John Browning. Tests held at our proving ground with this type of weapon show that one direct hit on an airplane with a projectile of this caliber fitted with a supersensitive fuze will cause the almost certain destruction of the plane.

WORLD WAR TYPE
CALIBER - - - - - - - 155 MM
WT. OF PROJ. - - - - - - 95 LB.
WT. IN FIRING POSITION - - - 25,960 LB.
MAX. RANGE - - - 17,800 YD.
NEW TYPE
1920 GUN
CALIBER - - - - - - 155 MM.
WT. OF PROJ. - - - - - 95 LB.
WT. IN FIRING POSITION - - - 24,000 LB.
MAX. RANGE - - - 25,800 YD.

The 155-mm. Gun of Today Compared with Its Predecessor

Our troops were equipped during the war with the Stokes Trench Mortar. This weapon became a very important one due to the extensive trench warfare in France. It was capable of throwing 3-inch high explosive bombs short distances with great rapidity. The accuracy of the weapon was, however, poor and difficulty was encountered in placing the bombs in the narrow enemy trenches. To obtain satisfactory accuracy, the small infantry rifled cannon, as illustrated, has been built. Actual firing tests with the new weapon indicate that it has satisfactory accuracy and more than twice the range of the war type mortar.

Tanks

The tank became so well known during the World War that it needs no special introduction or description. Suffice it to say that the War Department has recognized the importance of this new weapon by the organization of special Tank Corps units for manning this matériel.

The war-time models of tanks do not have all the characteristics found necessary by post-war study of tanks. In an effort to produce a more satisfactory tank, the Ordnance Department has built experimental models of the medium size for test. Our models of light and heavy tanks are reasonably good.

The Tank, Model 1921, is in the medium weight class and is of sufficient size and weight to be an effective fighting machine. This is probably the most useful size tank.

Some of the characteristics of this tank worthy of note are the high ends, which give good climbing ability, and the spring suspension of the running gear, which permits of a safe speed of 10 miles per hour. The armament is in revolving turrets, allowing all-round fire. The Tank Corps has operated and tested this tank and considers it as practically meeting the requirements for a fighting tank, although we are very anxious to reduce its weight from 20 tons, as it now stands, to not more than 18 tons. This problem is being actively attacked.

Mobile Artillery

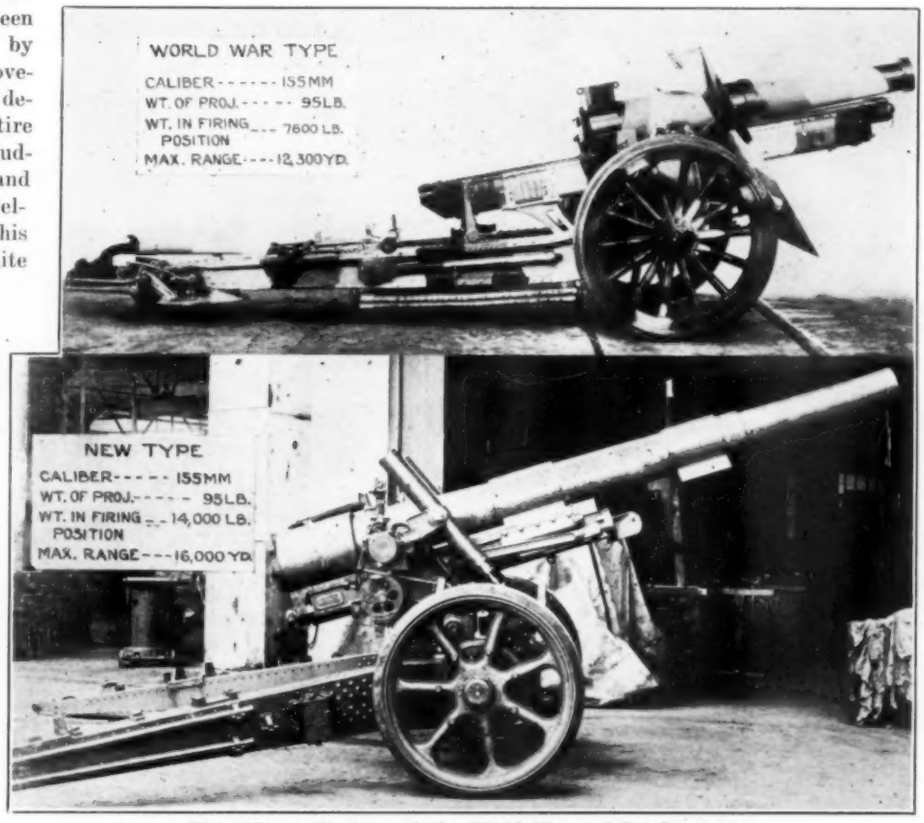
Divisional Artillery

The close of the War found our armies equipped with the French "75," American "75," and the British "75," as the divisional guns, and the 155-mm. howitzers of French design as the divisional howitzer.

If we consider the French 75-mm. gun as representing one of the best types of divisional weapons used during the war, it will immediately be noted that this gun can only be elevated to 19 degrees with a corresponding range of 9,700 yards, which means that the maximum efficiency of the gun can only be obtained by laboriously blocking up under the wheels of the carriage or by dropping the end of the trail into a pit. Even after doing this, it is found that the recuperator mechanism is not strong enough to return the gun to battery at high elevation, so that the rate of fire in this position would be seriously interfered with. It will also be noted that this carriage has a very limited traverse, the maximum amount on each side of the normal being only 3 degrees. Limited traverse for a divisional weapon is a serious restriction in modern warfare, due to the new rapidly moving targets which are now encountered, such as tanks, motor vehicles, etc.

The new divisional gun permits the high angle of ele-

vation of 45 degrees and the wide traverse of 40 degrees. Due to the great importance of the mobility of divisional weapons, which must accompany the division on the march, the Artillery arm of the Service has always—and for very good reasons—imposed upon the Ordnance Department the conflicting requirements of greater range and lighter weapons. They very eagerly accept any increases in range, but jealously guard against any material increase in weight. In the post-war 75-mm. weapon the range of the gun has been increased to 15,000 yards, while the total weight of the unit has remained essentially the same This has been accomplished by radical improvements in the design of the entire matériel, including the gun and carriage. Developments in this respect are quite satisfactory.


WORLD WAR TYPE
CALIBER - - - - - - 155MM
WT. OF PROJ. - - - - - 95LB.
WT. IN FIRING POSITION - - - 7600 LB.
MAX. RANGE - - - - 12,300YD.
NEW TYPE
CALIBER - - - - - 155MM
WT. OF PROJ. - - - - - 95LB.
WT. IN FIRING POSITION - - 14,000 LB.
MAX. RANGE - - - 16,000 YD.

The 155-mm. Howitzer of the World War and Its Successor

Divisional Howitzer

The 155-mm. Schneider howitzer was adopted in emergency as the divisional howitzer, although it was known at the time that it was too heavy and lacked proper mobility. It was properly a Corps Artillery weapon, for which it was also used during the last war.

The new 105-mm. howitzer is therefore not directly comparable with the 155-mm. weapon. The weight of this howitzer is about the same as the divisional gun, which means like mobility, while its great power is apparent from the range of 12,000 yards obtainable with a shell weighing 33 pounds, which is over twice the weight of the projectile used for the 75-mm. gun.

Corps Artillery

The function of the divisional artillery just described is primarily the destruction of the enemy's soldiers. The function of the Corps Artillery is the destruction of the enemy's divisional artillery, for which guns of heavier calibers and longer ranges are necessary. Artillery of this type should have ranges sufficient to cover the front of an army corps and of sufficient destructive effect for use as counter-battery weapons. For this matériel the Department has endeavored to produce a gun which would have a range of about 20,000 yards with a projectile not over 60 pounds, and a howitzer which should have a range of 16,000 yards with a projectile not over 100 pounds. It is found that the 4.7-inch gun and the 155-mm. howitzer best meet these requirements.

The American 4.7-inch gun which is the one used during the war as a Corps Artillery gun has a maximum range of about 14,000 yards with a 45-pound shell or about 12,000 yards with a 60-pound shrapnel. The new 4.7-inch gun, which has been built as a substitute for the war type, is much longer and a much more powerful weapon.

The 4.7-inch gun is logically mated with the 155-mm. howitzer as these two weapons are roughly of the same mobility and power, the howitzer making up in size of projectile what it lacks in range.

The 155-mm. howitzer, war type, is of the Schneider design. This weapon while a very excellent piece has a maximum range of 12,300 yards with a 95-pound projectile, while the new type which has been built as a substitute will give a range of 16,000 yards. The new 155-mm. howitzer, it will be noted, is quite similar in appearance to the 4.7-inch gun. The new carriage has a maximum elevation of 65 degrees and the very wide traverse of 60 degrees, as against 6 degrees obtainable with the war type carriage. It is interesting to note that the new 155-mm. howitzer can fire almost up to the range of the 155-mm. gun of war type, known as the G. P. F., which will be next described under the heading of Army Artillery. While the range of the new howitzer approaches that of the 155-mm. gun of war design, its weight is less than half that of the 155-mm. G. P. F.

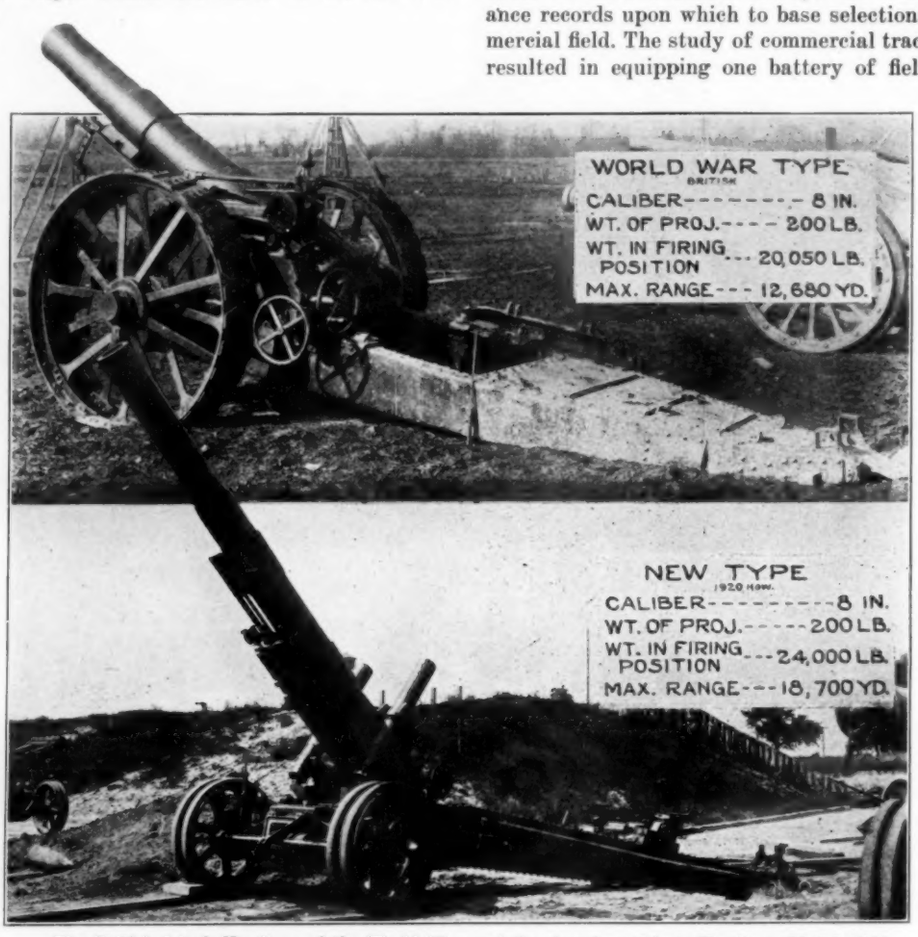
Army Artillery

Artillery of larger sizes than the ones which we have discussed are included in the Army, or general headquarters reserve artillery, and the first of this size is the 155-mm. gun.

This weapon was considered by all authorities as one of the best pieces of artillery brought out during the World War, and we have adopted its general characteristics in the design of our larger calibers. The G. P. F.

gun has a range of 18,000 yards, but in our post-war gun we have obtained a range of 25,000 yards with a 95-pound projectile. The new 155-mm. gun is capable of firing at an angle of elevation of 65 degrees, which will permit its use against captive balloons, and it has a total traverse of 60 degrees, which is the same as the traverse of the G. P. F. It should also be especially noted that while this gun is very much more powerful than the G. P. F. of war design, we have been able to keep the total weight within the limits of the G. P. F.

The 8-inch howitzer is the companion piece of the 155-mm. gun. This howitzer, with which our armies were equipped during the late war, was very serviceable, but was very much below the power desired in a howitzer of this caliber. The model shown has a range of 12,600 yards with a 200-pound projectile, although most of the howitzers used during the war were of a still earlier model, and had a range of less than 11,000 yards. The new howitzer which will replace the 8-inch war type howitzer is mounted on the same carriage as the 155-mm. gun previously described. It has a range of about 18,000 yards, which is the requirement set up as a result of our war experience.


WORLD WAR TYPE
BRITISH
CALIBER - - - - - - - - 8 IN.
WT. OF PROJ. - - - - 200 LB.
WT. IN FIRING POSITION - - - 20,050 LB.
MAX. RANGE - - - 12,680 YD.
NEW TYPE
1920 MOW.
CALIBER - - - - - - - - 8 IN.
WT. OF PROJ. - - - - - 200 LB.
WT. IN FIRING POSITION - - - 24,000 LB.
MAX. RANGE - - - 18,700 YD.

The British 8-inch Howitzer of the World War and the American 8-inch Howitzer, Model 1920

Tractors

At the outbreak of the World War, Germany was the only country well equipped with heavy artillery of the proper types. With the exception of the famous 75-mm. and 155-mm howitzers, the French armies were not well equipped with artillery, having practically no suitable heavy types. The British were also in the same state of unpreparedness. The close of the World War found all Allies equipped with heaviest types of artillery obtainable.

The extensive use of heavy guns accelerated the development of tractors for hauling this heavy equipment as a substitute for the horses which had been formerly used.

The Allies turned to the United States where the track-laying type of tractor was in production for commercial and agricultural purposes, and some of these tractors were used for hauling guns at the front before the United States entered the war.

Since the war, the Ordnance Department has built several types of experimental tractors for the various artillery loads and has been testing, at its Proving Ground and in the field, commercial types of tractors suitable for military service. It is the intention of the Ordnance Department to continue testing commercial tractors in order to have available always the necessary performance records upon which to base selections from the commercial field. The study of commercial tractors has already resulted in equipping one battery of field artillery with commercial tractors for field study.

As the commercial field has practically no production of very heavy tractors, the Ordnance Department will be required to carry on its own development of this type.

Antiaircraft Artillery

The antiaircraft artillery of the World War formed an important defense against aircraft. The value of these guns was measured not so much by the actual numbers of aircraft destroyed, as by their effectiveness in preventing aviators from carrying out their missions of raiding, bombing and observation.

It is, however, a matter of record that the effectiveness of the Allied antiaircraft artillery measured in terms of shots fired per plane destroyed increased three-fold during the last year of the war. This rapid increase in efficiency was due to the development of guns, ammunition, fire control, and the training of personnel.

The effectiveness of antiaircraft artillery can be greatly increased by construction of guns of higher muzzle velocities, better fuzes, and improved fire control instruments.

The 3-inch antiaircraft gun, Model 1923E, has just been completed and represents the best type of weapon produced up to this time. The gun, carriage, and trailer are very light, so that the unit possesses excellent mobility. The gun which has a muzzle velocity of 2600 foot-seconds is of higher power than the antiaircraft guns in general use during the war period. Further radical improvements in our antiaircraft artillery may be expected.

Ammunition

In discussing artillery, one is apt to pass over the ammunition problem as relatively unimportant, yet it is the propellant in the round of ammunition which furnishes the motive power, and the projectile with its delicate fuze mechanism and bursting charge that produces the effect upon the enemy.

Each 75-mm. gun will, during its accuracy life, shoot more than 60 times the combined weight of the gun and carriage. Put in another way, out of the total estimated yearly steel requirement of the Ordnance Department in time of war, 6 million tons, 3¼ million tons are required for the manufacture of ammunition alone.

Some of the increase in the ranges obtained with the new types of artillery just discussed is due to improvements in the flight of projectiles achieved by perfecting the shape of the exterior of the projectile and by paying special attention to the balance of the shell.

In passing, it may be mentioned that in the field of propellants, smokeless powder has been manufactured for divisional artillery, which is flashless as well as smokeless. This powder when fired at night gives a dull glow at the muzzle instead of a blinding flash.

The use of flashless powder renders the location of the firing battery by the enemy more difficult. The noise is also greatly reduced as compared with the older types of propellant powder.

NEW TYPE
CALIBER - - - - - - - 4.7 IN.
WT. OF PROJ. - - - - - 50.5 LB.
WT. IN FIRING POSITION - - - 11,600 LB.
MAX. RANGE - - - - 20,000 YD.
WORLD WAR TYPE
CALIBER - - - - - - - 4.7 IN.
WT. OF PROJ. - - - - - 45 LB.
WT. IN FIRING POSITION 8,068 LB.
MAX. RANGE 14,000 YD.

Evolution of the 4.7-inch Gun

Superguns

Railway Artillery

The war hastened the use of guns and howitzers of large caliber mounted on railway carriages, and many different types were produced and used with great effect by both sides. Since then the railway mount has been still further improved and special consideration has been given to the use of this type of artillery for seacoast defense purposes.

The 14-inch gun railway mount, Model of 1920, is mobile in that it can be transported over the average railway lines, and its dimensions are such that it will pass through standard railway clearances. The unit can be fired either from the track, or, if time permits, it can be lowered down and bolted to a concrete foundation.

It is equipped with its own power plant, which permits the use of electric motors for elevating the gun, traversing the whole carriage, handling the ammunition, and for compressing the air required for gas ejection. The range of this weapon is approximately 23 miles with a 1600-pound projectile, and it can be fired at the rate of at least 1 shot per minute.

Seacoast Artillery

In seacoast artillery the principal improvements have also been in increased ranges due to higher powered guns and increased elevations. The maximum range of the new 16-inch guns which are being emplaced in the Panama Canal and our important harbors is 27 miles with a projectile weighing over 1 ton. The new weapons are electrically operated, and although the weight of a complete round of ammunition is nearly 3,000 pounds, the gun can be loaded, accurately aimed, and fired at a moving naval target once every 50 seconds.

German Long Range Gun

Any discussion of large caliber heavy guns always brings to mind the German "Big Bertha" which alarmed the Allied world by firing on Paris. At 7:15 on the morning of March 23, 1918, just two days after the Germans opened their offensive against the British Army before Amiens, people of Paris were startled by the loud explosion of something that had fallen on Quai de Seine. Fifteen minutes later there was another explosion of the same magnitude, but this time on the Rue Charles V. Fifteen minutes later another explosion occurred in the Boulevard de Strasburg. This bombardment continued between March 23 and August 9, and during that time 183 shells fell within the walls of Paris and 120 shells fell outside, resulting in the death of 620 and the wounding of 256 citizens.

That this bombardment of Paris did not prove to be a factor of importance in the final outcome of the war is now appreciated. The moral effect on the inhabitants of Paris was to cause an exodus of a large number of the unemployed into the country. The laborers in munition factories and other war workers remained at their posts, and the flow of war material was not sensibly diminished.

It is now known that the guns used were 210-mm. in caliber, or about 8 inches. Although it was agreed under the terms of the Armistice that these guns should be delivered to the Allies, they were promptly destroyed by the Germans, but from the information now at hand it is known that they were high-powered guns of long length using extremely high powder pressures. The projectiles, which weighed only 263 pounds, were too small for the task which had been assigned to them. The use of small caliber, extremely high-powered guns at exceptionally long ranges is of doubtful value and can not be considered a profitable investment of funds or of manufacturing facilities. Recent tests have demonstrated that the aerial bomb is a much more effective weapon for such long range

bombardment. Experiments indicate that in the future the airplanes will become a valuable adjunct to our long range heavy artillery, and will quite possibly limit the development of the great caliber guns which would otherwise be constructed in the future to obtain ranges comparable with those of the German "Bertha" with projectiles of sufficient size to be effective.

Bombing

The Ordnance Department is charged with the design and production of aerial bombs and their supply to the Air Service. The opportunities for development in this line of ordnance have been great, and considerable progress has already been made. No bombs greater in weight than 660 pounds were dropped on either London or Paris during the war, and we now have bombs six times as large.

A great many different targets can be effectively attacked by this powerful new weapon of warfare. Munition plants, ammunition dumps, railway bridges, storehouses, naval vessels are some of these. Heretofore such targets have been attacked by artillery when they were within range; however, the range of guns is limited, and through the airplane and the bomb these targets can be reached 100 miles or more beyond the theater of actual conflict. With the great variety of targets opened to attack, there have been developed the various classes of bombs, each designed to produce the greatest destruction against a certain group of targets. Of these bombs the demolition class is the most important. They are designed to destroy targets typified by the average factory building. They are made in different weights from 100 pounds to 4,000 pounds. The only limit to large bombs of this type is that which aircraft can carry. It is believed that the largest size needed at present does not exceed the 2,000-pound bomb.

Experiments are in progress with a 4,000-pound bomb to determine whether one of this size is required. This bomb is probably larger than any produced by any other country. The fact that it will excavate a crater 57 feet in diameter by 19 feet deep in average ground is an indication of its power. Such a bomb might be used against the latest capital ships, against a large manufacturing plant, or in bombing an extensive railroad terminal.

Approximately 50 per cent of the bomb by weight is high explosive. Its capacity for explosives is very large when compared with that of the artillery projectile, which carries only 2 to 15 per cent by weight. When a high explosive charge is detonated, a blast is produced and the destructive effect increases with the amount of explosive in the charge. The design of most buildings and other material targets is such that they are very susceptible to destruction by blast, therefore a demolition bomb carrying a large amount of explosive is a very effective agent against such targets, and for this reason the bomb is more effective than the projectile of the same weight.

The average factory is most effectively destroyed when a direct hit is made, although if a bomb of sufficient size hits near a building, it will produce very material damage. In the case of a direct hit, in order to get the full effect of the blast produced, detonation must be delayed until the bomb has passed through the roof and floors of the building and reached the ground floor or basement. The blast then literally bursts the building, throwing the roof off and demolishing the walls. That demolition bombs can be effectively used in the attack of naval vessels has been demonstrated in the experiments which have been conducted quite recently. An armored ship is more easily damaged by a near hit than by a direct hit. Using a fuze with a slight delay, the bomb can be made to penetrate 40 to 60 feet below the surface of the water before functioning. The water then acts to transmit the terrific shock of the detonation to the unprotected hull of the ship.

The bombing of the ex-German battleship *Ostfriesland* took place off the Virginia capes during the month of July, 1921. A 2,000-pound bomb striking close to this battleship caused it to sink very rapidly.

As a branch of modern ordnance, no subject is receiving more careful attention than the development of bombs.

Conclusion

It is hoped that the preceding résumé will have given you some idea of the rapid developments which have taken place in ordnance matériel since the World War. These developments were greatly stimulated by the help given during the latter part of the war by the scientists and engineers of the country, who were able to devote a great deal of time to this work. In time of peace these improvements will continue, although at a slower rate, so that over a period of a number of years, there will be many radical changes in the weapons of modern warfare. These considerations make it uneconomical to maintain too large a stock of war material on hand. It should be understood, however, that a reasonable reserve of war material is an absolute necessity, as otherwise the armies, in the case of an emergency, could not be armed for many months after the declaration of war. A carefully balanced reserve of the best ordnance matériel obtainable must therefore be kept, in order to equip and supply troops until new matériel can be obtained from new production.

It was clearly demonstrated during the World War that man power could be much more quickly raised and trained than the armies could be equipped with the proper ordnance matériel. The mobilization of industry was found to be just as important a factor as the mobilization of man power.

Modern ordnance is used in such vast quantities by modern armies that a war requires a complete mobilization of the entire industry of the country. Ordnance is difficult to manufacture, being in general more difficult of fabrication than most commercial articles. Peace-time industrial preparedness measures are as important to the safety of the nation as the peace-time preparation of armies.

In conclusion it may be stated that while man power, other things being equal, remains and always will remain the deciding factor in war, the tremendous growth in quantity and complexity in the special instruments of war renders their supply the limiting factor in the development of the military effort of our nation and in making our man power effective.

The weapons used by men are but tools, and nations armed with inferior weapons may be hopelessly handicapped. A preponderance of numbers may make up for the inferiority if it is not too great. Our duty is not to prepare for war as a game in which the uncertainty of victory will add interest and zest to the conflict; it is to insure that, if war unfortunately comes, the United States will be able to make the most effective use of her resources with the object of securing a successful peace as quickly as practicable.

Defense Day, 1924, in the Ordnance Districts

By

JOHN B. BELLINGER, JR.

DEFENSE DAY, 1924, was a busy one for the Ordnance Districts. Reserve officers who were invited to participate responded, wherever possible, to the call; speeches were made by District representatives; manufacturers lent their whole-hearted cooperation to the work. The spectacle was gratifying in the extreme to all who have the welfare of our country at heart.

The New York District Office held meetings every day during the week preceding the test and when Friday, September 12th, arrived, reserve officers and manufacturers began to report at the temporary offices in the Engineering Societies Building.

These offices had been completely furnished for the occasion by the Globe-Wernicke Company, and the New York Telephone Company lent generous support by installing a telephone switchboard with twenty-five extensions. A radio station was provided by the Radio Corporation of America, while the Western Union Telegraph Company, not to be outdone, sent their latest multiplex printing telegraph installation, capable of transmitting six hundred words per minute.

Reserve officers, over one hundred in number, reported to assume their share of the patriotic task. More than a hundred manufacturer's representatives participated.

At three o'clock in the afternoon an open meeting was conducted in the General Auditorium of the Engineers' Building. Some seven hundred manufacturers, reserve officers and engineers who attended were addressed by Colonel Walsh, General Bullard and General Tripp. Judge Gary presided. The addresses delivered at this meeting are appended to this article.

The Philadelphia meeting was attended by an enthusiastic gathering that filled to capacity the large board room of the Union League Club and overflowed into the corridors. Mr. Jones, District Chief, who made the address, discussed at length the duties of the various divisions and sections of his office. In conclusion, he requested his World War assistants, many of whom were present, to furnish him with written reports covering their detailed views on the organization plans.

The Philadelphia District Ordnance Office in the Widener Building was turned over to the Committee on Commercial Organizations for use as a headquarters and the District Ordnance Office extended its hearty assistance and cooperation.

In the Buffalo District twenty-five of the thirty-three reserve officers assigned, reported either in person or by mail. Those who reported in person met in the office of the District Chief, where he explained the progress made to date, outlined their respective duties in case of emergency, and covered the main points of the War Game. Officers from Watervliet Arsenal then explained briefly what steps the Arsenal would take to increase production.

After luncheon, those who attended the meeting separated in order to participate in the various parades. The Buffalo Ordnance District Unit, comprising about fifty men, marched in the Albany demonstration.

Senior officers of the Bridgeport Office assembled in the morning to discuss the general situation with regard to War Orders already placed. At two o'clock, thirty-three reserve officers assembled and, under the assumption that the emergency was in effect, War Orders were put into production. All plants in the District had previously been visited and brief reports covering the existing situation at each had been prepared. These reports were furnished to the section chiefs, who assembled their officers and discussed with them the action to be taken.

At four o'clock the officers gathered for a talk by the District Chief on the general situation. Division heads then reported on their special tasks. From five until seven o'clock the District Office as a unit took part in the local demonstration and afterwards met at dinner to discuss plans for work during the coming winter.

The Pittsburgh Office held a meeting which lasted from 10:30 a. m. to 12:30 p. m. During this conference, attended by personnel assigned to the District, the status of mobilization plans in the Pittsburgh District was discussed. Mr. Dravo, Chief, and several prominent manufacturers addressed the gathering. Captain Root, Executive Assistant, told the reserve officers and civilians present that the District plans had been perfected and that the manufacturers were ready to start their activities upon notice of war. He impressed the importance of industrial mobilization upon his hearers, stressing the fact that the work of procurement units would continue indefinitely as additional plant surveys were undertaken from year to year.

In Cleveland, reserve officers reported for conference on the afternoon preceding Defense Day and at various times on September 12th. Others reported by telephone or telegraph.

The District Chief in Detroit gave a luncheon at the Detroit Athletic Club, which was attended by nine prominent business men who have been selected as heads of divisions. This being the first formal meeting of the District Chief's civilian aids, great interest was manifested by all concerned and further conferences were arranged in order to familiarize individuals with the duties that each would be expected to perform in case of emergency.

Reserve officers assigned to the Detroit District were requested to assemble in the District Office at 7:00 p. m. on September 12th. Those unable to be present reported by mail, telephone or telegraph. Those present were addressed by the District Chief, who outlined the purpose of Defense Day and told them of the progress being made in District plans.

Later in the evening the District Chief and his officers attended a meeting at the Detroit Board of Commerce where addresses were delivered by the Mayor and other prominent speakers.

The St. Louis District Office started on September 5th

to draw up its plans pertaining to the War Game and on September 12th reserve officers assigned to the District and living in St. Louis were requested to assemble in the District Office. Three of the six officers in town reported and a conference was held on the completed draft of the War Game.

Of the remaining twenty-eight officers assigned to the St. Louis District, reports were received from twenty of them with information that they intended to report for parades held near their homes.

Reserve officers of the Baltimore District reported at various times during the week previous to Defense Day and were given problems to develop in connection with the War Game. Only two of the officers assigned to the District reside in Baltimore and, of these, one was able to join in the Defense Day demonstration.

In the Cincinnati Office those reserve officers and civilians who have been selected to fill important positions in the District organization took part in the War Game under supervision of the District Chief. On September 12th they attended a luncheon at the Chamber of Commerce and participated in the local parade. Letters were sent to out-of-town officers urging them to join in their local demonstrations.

The Birmingham Ordnance District officers reported on September 12th, either in person or by telegraph. The officers who reported in person took part in the parade and patriotic meetings held afterward. In the parade were twenty-one floats bearing products or machinery of the industrial organizations they represented and bearing placards emphasizing the necessity for preparedness. Two speeches were made during the day by the District Chief.

Attendance at the San Francisco District War Game totaled about twenty, great interest in the project being displayed by all who attended. Through the courtesy of the Federal Copper Company, a large conference room was secured, which permitted uninterrupted meetings throughout the week of the War Game. Both reserve officers and contractors took part and it is believed that these conferences accomplished as much in a few days as the District Office, unaided, could have accomplished in months.

On Defense Day a joint luncheon of the San Francisco procurement districts was held at the Army and Navy Club. Those who attended, fifty-three in number, listened to an interesting address by Mr. F. T. Letchfield, Director of the Industrial Department, San Francisco Chamber of Commerce. After luncheon the guests visited the Civic Center where they registered for the day at the temporary headquarters of the 91st Division. They then inspected the various War Department exhibits in the Auditorium.

These exhibits were held in space allotted to the different procurement districts and consisted of organization charts, drawings, copies of correspondence, etc. Though it was impracticable to include samples of actual matériel, the interest manifested was extremely gratifying. A large number of people visited the Ordnance booth and spent some time in looking over the display.

A conference was held in the Boston District Ordnance Office from 10 a. m. to 11 a. m., during which the manufacturers and reserve officers present discussed the subject of industrial mobilization. At 11 a. m., the reserve officers went into conference with their respective section chiefs, while the manufacturers discussed their problems with the District Chief and his advisers. At noon those who attended the meeting lunched at the Exchange Club as guests of the District Chief and afterward separated to take part in the local demonstration.

The Chicago District reserve officers responded with enthusiasm to the call of September 12. Of the seventy-nine assigned, most of them reported in person and the remainder by telephone or telegraph. Two meetings were held at noon, when a message was read from the Commanding General, Sixth Corps Area, to employees of industrial establishments and speeches were made by the Executive Assistant. A conference, attended by twelve reserve officers, was held later in order to begin an analysis of the War Game.

The reserve officers afterward attended a luncheon at Corps Area Headquarters, later going to Lincoln Park for a parade and demonstration.

Defense Day in the Ordnance Office was largely devoted to receiving ordnance reserve officers assigned to duty in that office in the event of an emergency. The Regular Army officers and civilian personnel of the office organization were on duty in the several subdivisions of the office to receive the officers reporting and explained to them the organization plans and discussed with them particularly the specific assignments of reserve officers as they stood on that day. This permitted the reserve officers to become acquainted not only with the regular officers and civilian personnel of the office as at present organized, but enabled them to meet other reserve officers present on that day.

During the course of the morning, the reserve officers had an opportunity to go to the War Department and meet General Pershing personally. The Chief of Ordnance, Major General C. C. Williams, made a personal inspection of the entire Ordnance Office. The morning closed with a general assembly of all commissioned and civilian personnel in the Ordnance Model Room where the Chief of Ordnance addressed the assembly informally, discussing in some detail the War Department mobilization plan, the mission of the Ordnance Department, and the Ordnance Department plans for accomplishing its mission. Following General Williams' address, the Assistant Chief of Ordnance and Chief of the Manufacturing Service, Brigadier General C. L'H. Ruggles, read and discussed the report of the Chief of Ordnance to the Chief of Staff on the status of the Ordnance Department mobilization plan. The assembly concluded with a presentation of all of the Ordnance reserve officers present to General Williams, General Ruggles and General Joyes.

All officers and the majority of the civilian employees of the Ordnance Office participated in the parade which was the principal feature of the afternoon program in Washington. Immediately after the parade patriotic exercises were held just south of the White House, the principal features being addresses by the Secretary of War, Hon. John W. Weeks, and by General John J. Pershing, Chief of Staff and General of the Armies.

All in all, Defense Day particularly as it related to Ordnance and Industrial Preparedness was a tremendous success. The spirit of cooperation, the will to do, and the desire to help marked the participation of those interested in, or officially assigned to, Ordnance throughout the country. The actual measure of success may be difficult to appraise—its influence is more far-reaching than a mere recounting of the affair can indicate. In the Ordnance Department and in the Ordnance Districts Defense Day, 1924, accomplished its purpose: it was a day of study and self-examination and found the house in order.

New York District Defense Day Meeting

At the New York meeting Judge Gary, Chairman of the United States Steel Corporation and a member of the Army Ordnance Association, presided. His remarks follow:

Judge Gary's Address

"Ladies and Gentlemen, I hold in my hand a telegram from the President of the United States, which I will read—

'Please be good enough to communicate my good wishes and the assurance of my deep interest in the purposes of the gathering which is being held today by leaders of the industrial and engineering activities of the country. The national power in these departments is one of our firmest reliances for prosperity and security.

CALVIN COOLIDGE.'

I also have a telegram received from Major General C. C. Williams, Chief of Ordnance—

'On this Defense Day it is a comforting thought to know that the New York District Office is backed up and seconded in its efforts by such an Advisory Board as the one you head. The Ordnance Department in its problems touches the commercial activities of the nation to a marked degree and cooperation is vital to success. It will be due to such organizations as yours that this intelligent cooperation can be secured. Best wishes for your organization whose efforts are deeply appreciated by me.

WILLIAMS,
Army Ordnance.'

Our nation is rich and resourceful; populous and progressive; courageous to the full extent of propriety. It insists upon respect for its rights, and likewise gives full recognition to the rights of all others. It stands for peace, honesty, fairness and friendship in its intercourse with other nations.

It has become a leading, strong and influential factor in world affairs. It is destined to be even greater if its people are sufficiently wise to improve their opportunities. If we are industrious, economical, absolutely just in our treatment of each other, strictly loyal to our national government and its administrators, we, the people, may expect to continue prosperous and to remain secure in the enjoyment of all the benefits that this highly privileged land affords.

But as long as humanity is more or less governed by motives not in accord with the spirit of Christianity, our country is in danger of possible attack by those who may believe they are more powerful, whatever the reason advanced may be, or however cupidity, envy, fancied wrongs and other unworthy impulse may direct.

Officials of New York Ordnance District Who Participated in Defense Day Activities

Front row, left to right: Herbert T. Howell, Gen. Guy E. Tripp, Gen. Samuel McRoberts, Gen. Robert Lee Bullard, Judge Elbert H. Gary, M. Friedsam, and Patrick E. Crowley; Back row: Capt. H. W. Churchill, Maj. C. E. Davies, Lt. Col. R. D. Coombs, Lt. Col. F. W. Roller, Maj. Crosby Field, Col. James L. Walsh, Maj. J. E. Fullam, Lt. Col. Ross H. Harrison, Maj. J. B. Elmendorf.

The Lord Almighty, merciful and all wise, does not absolutely protect those who unreasonably fail to contribute to their own safety; but He does help those who, to the extent of their own ability and understanding, help themselves. This is fundamental theology.

Every nation that has what is valuable, is obligated to be prepared to defend against brutal attack or unjust effort to seize and appropriate. Even though a man is not inclined to guard the interests of himself, common decency requires him to furnish reasonable oversight and care to others who are weak and helpless. As a rule, they who preach in words or action peace at any price, are not possessed of anything worth having and are oblivious to the interests of others, including even their own dependents.

It is believed a vast majority of the peoples of all countries, including our own, favor preparation for defensive war in case it should be wrongfully forced upon them. This attitude is moral, logical and sound.

The United States should continuously and permanently maintain a condition of safety against unwarranted assault. And this should be provided at the very lowest cost. A dollar of prevention is worth thousands of cure.

We know by the experience of 1914-1918, that the cost of the war was many times as large and the victory much longer delayed by reason of the lack of preparation on the part of the nations that defended. Billions of money and millions of men were lost as the result of neglect or indifference.

Every good soldier or civilian loves peace, and hates war if it can honorably be avoided. It is to insure peace, to prevent war, if possible, and to more speedily end war when improperly waged, that the intelligent man or nation advocates or consents to defensive preparation.

The splendid Army of the United States of America, openly and enthusiastically supported by a wise, honest, economical government, entertains the belief that the best interests of the country and all its inhabitants, without discrimination, demand the establishment and maintenance of a basis, at the lowest cost, for mobilizing and, if necessary, utilizing all the available resources of the nation, in the shortest time and most effective manner, to defend against military forces, if and whenever or however we may be attacked; and to this end has organized military divisions throughout the country to provide and systematize the necessary measures. Of vital importance are included the industrial facilities.

The members of the Advisory Committee take pleasure in offering their hearty and cheerful support to the Army. They will cooperate to the best of their ability. They feel justified, by positive assurances received, that the industrial forces throughout the nation will patriotically join in the effort to carefully, wisely and economically safeguard this peace-loving country and all its people against any attempt at unjust interference with their rights or interests. We are here today to consider what we can do."

Remarks by Colonel Walsh

Col. James L. Walsh, the New York District Chief, who was the next speaker, said in part:

"The outstanding lesson of the World War was the demonstrated fact that, relying solely on our own resources, American man power could be drafted, organized and trained to battle efficiently at a rate which far surpassed the rate at which we could *arm* and *equip* our man power for effective employment in battle.

We had abundant warning of this state of affairs from those in a position to know the truth. Time and again, General Crozier told Congress and the American people that all other preparations—in organization, personnel, and matériel—could take place faster than the manufacture of arms and ammunition, which, therefore, sets the pace at which the country can make ready to defend itself.

We ought to have realized the truth of this contention, but we didn't. It is easier and quicker by far to teach men how to shoot rifles than it is to teach them how to make rifles, just as it is easier and quicker to teach persons how to drive automobiles than it is to teach them how to manufacture them. But the Plattsburgh idea concentrated popular attention on man power to the almost complete exclusion of considerations affecting munition power. As a result, we had very few available instructors in the manufacture of arms and ammunition, as compared to the thousands who could teach the use of these arms once they were manufactured. The National war effort was, therefore, critically out of balance. That we were able to overcome our deficiencies in munition power with the generous assistance of the Allies should not be permitted to obscure the lessons of our recent experience.

Prior to the World War, it was generally considered that adequate military preparedness was largely a question of trained man power. Our war plans consisted principally of instructions for the mobilization of men, their organization into units, regulations for maneuvers and for training in the use of arms—with but little thought as to how those arms would be provided. We now know that munition power, and not man power, is the critical factor in preparing for the National Defense. If we are wise, we shall be guided accordingly.

We have 17,000,000 physically fit men of military age in the country, but no matter how smoothly we draft them to the colors, no matter how well we clothe them, and house them, and feed them, no matter how generously we pay them, they cannot be considered soldiers until we put in their hands the tools of their trade, collectively called "Ordnance." Until they achieve effective striking power through the employment of modern implements of war, they are merely so much cannon fodder for the enemy.

In 1917, due primarily to general lack of interest in the subject, we had no well thoughtout plans for promptly starting this huge production program of ordnance needed to equip our man power. As a result, our munitions program lagged nearly a year behind our manpower program.

We converted our citizens into soldiers with six months' training—thousands of brave lads went into battle with even less—and acquitted themselves creditably—but it was nearly eighteen months before it could be said that our munitions program was fully under way. It is only fair to say, at this juncture, that the delay was not chargeable to American industry in general. Part of the delay was unquestionably due to difficulties inherent in the problem, and we shall without doubt encounter these same difficulties if unfortunately war should again be thrust upon us. Industry responded

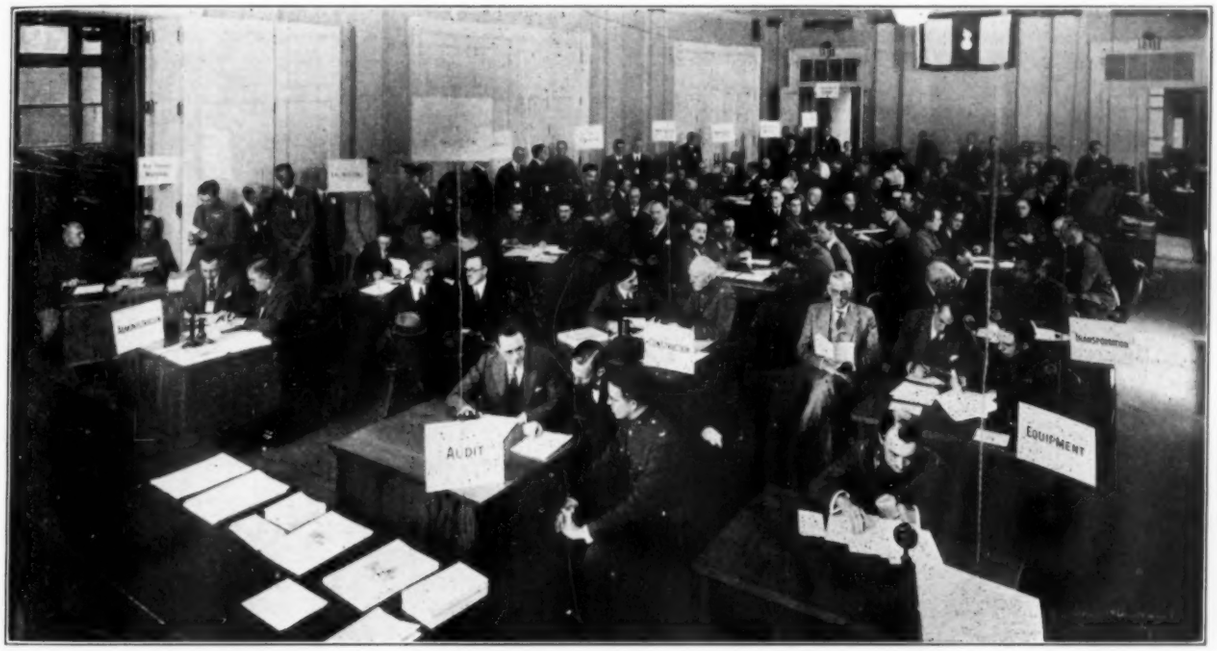
magnificently as soon as it was informed what was wanted, but nearly six months were used up in determination of requirements, establishment of designs and specifications, examination of facilities, negotiation of contracts, and other preliminaries to the inauguration of actual production. Most of this sort of thing could easily have been done before the declaration of hostilities, certainly half of it could have been avoided, even allowing for last minute changes. Congress could and did appropriate billions of dollars, but they did not and could not appropriate a single second of time. And that is what we are now trying to do—to appropriate time. By doing now, in time of peace, those things which can and should be done ahead of time, we hope to save at least half the period wasted in needless backing and filling which characterized our last attempt. In short, we are trying to achieve a reasonable state of industrial preparedness, a subject of immediate and vital importance to American Science, Engineering and Industry, on whom will fall the first and heaviest burden in the event of war.

With the lessons of the World War fresh in mind, the War Department is now trying to so plan ahead, that if war is again thrust upon us, industry can take up its allotted war-time tasks with a minimum of delay and a minimum of disturbance to its economic structure. Enlightened self-interest alone should insure industry's hearty cooperation to this end.

If what we are now endeavoring to accomplish had been done prior to our entrance into the World War, it would have saved the Government a tremendous amount of money and many needlessly sacrificed lives. Our expenditures during the two years beginning in April, 1917, averaged a million dollars an hour—about twenty-five millions a day—and what we are now trying to do is to shorten the duration of the next war, if one should come, by at least ninety days. If we are only partially successful, if we only save forty days, we will still save to taxpayers a round billion of dollars—based on our World War experience.

One of these time-consuming preliminaries can be put aside as having been completed. The determination of the kinds and quantities of various munitions is behind us. To properly estimate the magnitude of this phase of the problem, I might say that it required the services of fifty officers and proportionate clerical assistance over nine months to compute the requirements of the War Department under the present mobilization plan. In ordnance alone, it was found that there are some twelve hundred major items of issue, comprised of over 250,000 separate and distinct components.

All of our armament has been carefully reviewed in the light of its performance during the World War, and the Ordnance Department is today able to say, in the event of war: this is the shoulder rifle we will put into production, these are the standard types of ammunition for it, this is the adopted cannon for divisional artillery, this is the tank we want, etc., etc.—a definite type has been selected to be put into immediate production in the event of war.



Preparedness Drill at New York District Ordnance Office, Defense Day, 1924

The next phase to be taken up is the survey of existing facilities with a view to proceeding toward the negotiation of tentative contracts. Here we are trying to improve upon the methods which obtained during the World War—when a great majority of prime contracts were negotiated in Washington with resulting congestion which halted progress, at times almost to a standstill To correct this condition, the whole country has been divided into fourteen industrial districts, and a District Office established in the principle city of each area.

A District Chief has been appointed for each District, charged with the procurement, production, and inspection of such ordnance material as may be assigned to that District in the event of an emergency. Similarly for Air Service. These District Chiefs are not officers of the Regular Army, but civilians appointed on a dollar-a-year basis, to supervise the activities of the Regular Army officers who perform the actual detail work. Several plants in the New York District have already been ex-

amined and tentative allocation of orders made. We are now ready to undertake the actual negotiation of contracts. The War Department has endeavored to standardize the forms of contract to be used in the event of emergency. This work has been under way for over two years, and it is hoped that these new types of contract will be equally satisfactory to the Government, and to the representatives of American industry, who have given unsparingly of their time and advice to this end. Inasmuch as Ordnance contracts during the World War totaled thirteen billions of dollars in value, the importance of going into this matter in the most thorough manner possible is obvious.

Here in the New York District, tentative orders are being placed as soon as possible after receiving allocations from the War Department. The Ordnance Department wants our help and advice—this problem is not theirs alone—it is ours also. On us will fall the burden of actual production in the event of war.

At present, we are making haste slowly. It is estimated that it will take fully five years to complete all phases of the entire industrial preparedness program. In the first place, the War Department hasn't the officers to spare for this work, and in the second place, the reserves of ordnance left over from the World War are, at this time, sufficient to insure arming our man power as fast as it can be organized and trained. However, these reserves are lessening. Due to service requirements and salvage, our small arms ammunition reserve will be probably valueless by 1928. In the meantime, we shall try to have the preliminaries to production in such shape that these reserves can safely be reduced to a great deal below the figures as now established. Munitions reserves are designed to bridge the gap between the declaration of war and the beginning of actual new production of war matériel. Manifestly the quicker we can get into production after war is declared, the smaller reserves will be needed, and—a fact not to be lost sight of—the smaller appropriations will be required to insure adequate industrial preparedness.

Without the help of American industry, the War Department can accomplish little or nothing. But if each of us will pitch in and do a little bit, I am confident that we can make real progress. If we can achieve a degree of industrial preparedness that will match our man power, we can make our country an effective factor in keeping the peace of the world. Incidentally through obviating the necessity of maintaining in times of peace huge stocks of war material, we will permit with safety a nearer approach to actual disarmament than we have ever heretofore known."

General Bullard Speaks

The Chairman then introduced Major General Bullard, Commanding General of the Second Corps Area, who said in part:

"I believe that today is the happiest and most satisfying day of my military career of forty years. The way the civilian and industrial reserves responded to the Defense Day idea was nothing short of wonderful. It indicates the most encouraging state of mind on matters of peace and defense I have ever known to exist in this country. The people of the United States will some day thank God for the accomplishments of the day and for the Advisory Board which has charge and the work it has done and will do.

If we are forced to fight again, I know that we shall not need to scour the country for gunny sacks nor hunt around for string. We shall have it, and we shall have it when we need it, not a year later. For a successful defense, supplies and munitions are more important than men. Men may be trained quickly if the supplies and munitions are at hand.

An ounce of prevention is worth a pound of cure. Preparation for a dire event almost surely prevents it. The work of Defense Day is of first importance and is a great accomplishment."

In introducing General Guy E. Tripp, Chairman of the Westinghouse Electric and Manufacturing Company and a recently elected vice-president of the Army Ordnance Association, Judge Gary said:

"General Tripp, Chief Officer of the great Westinghouse Company, at the request of the Government, secured leave of absence from his work, went to Washington and participated in the work that was being done by industrialists and civilians in behalf of the Government. Of course, they made him a General in spite of himself, as a slight token of reward for his services. Here he is, gentlemen, on this Committee, devoting his thought and his time, and we have asked him to speak to you today. We turn over the meeting to him for a few minutes and we hope you will give him all the time he wants."

General Tripp's Address

General Tripp said:

"For the first time in the history of the United States, American industry is being given an opportunity to learn what its war-time work may have to be. Heretofore we have consistently ignored the fact that we might ever be at war. If that policy had really saved us from fighting, I would be the last man to suggest a change. But, unfortunately, in spite of our best intentions, we had to fight in 1812, 1845, 1861, 1898 and 1917, and each time in a truly dreadful state of unpreparedness. The consequences were the unnecessary expenditure of vast sums of money, great hardships to our troops, a loss of time which meant the loss of many lives, and on all except the last occasion a great deal of dishonesty on the part of contractors.

I do not think that even the most perfect of preparations is going to make war a pleasant thing for this country. Industry suffered greatly during the last war and will probably suffer worse if there is another. But at least we can minimize our difficulties, not especially for the sake of industry, but for the sake of human beings who will bear the real burdens, because to help them is industry's job.

The plans for industrial defense that have been prepared by the War Department are undoubtedly the most satisfactory solution yet presented to the problem of getting industry on a defense basis with the maximum of rapidity and the minimum of friction. They are thoroughly practical, and consequently American industry is gladly cooperating in them.

Many of you who are here have keen personal recollections of the state of affairs in Washington at the beginning of the World War, when all contracts were being negotiated in Washington and the congestion at times became so terrific as to bring all effort pretty nearly to a halt.

In the fall of 1917 I was asked by the Ordnance Department to accept the job of Chief of the Production Division, which in brief meant seeing that we got some actually finished articles of ordnance as a result of the $8,000,000,000 worth of contracts negotiated with great skill by General McRoberts. I may say, in passing, that though these contracts surpassed in the aggregate those placed by any other unit, not a charge of spending a single penny wrongfully has ever been made against the Ordnance Department or the officers who worked with it.

In view of the congestion at Washington, the decentralization of authority appeared to be necessary; and after a good deal of discussion and much thought, we divided the country into twelve industrial districts, one of which comprised the industrial area centered in New York. It was out of the question to change the system instantly, but by taking progressive steps we were able to establish on July 9, 1918, the New York Ordnance office in practically the form with which it ended the war.

A skeleton of this same form is the basis on which this office is being reestablished today, except that it is to have an important additional function; namely, 'procurement,' which means a survey of the plants allocated for orders and the actual negotiation of contracts. In the most undesired event of another war, few if any contracts will be placed at Washington. The large manufacturers who will undoubtedly be called upon to produce war supplies will receive their instructions from the New York District Office, and only in the rare case of an appeal will there be any need of commuting back and forth to Washington as so many were compelled to do during the late war.

By intelligent planning, the Reserve Ordnance Corps has set up shop and can be ready for business in fifteen minutes instead of fifteen months. It looks as though they have done a pretty good job and it is up to industry to match it.

I can see, however, that it will take several years before everything is in first-class shape, and I want to counsel patience, as well as cooperation, on the part of industry. Ninety-nine per cent of this work is being done, and will continue to be done, by reserve officers who are giving part time service to the Government without pay. Obviously this is saving the taxpayers an enormous expense; and, though things will not move so rapidly as would be the case if a large and efficiently paid staff were handling the details, we are all going to learn in the near future what our war-time work is to be and on what basis we can proceed to its accomplishment without its costing the nation a lot of money, directly or indirectly.

All Americans owe a great debt of thanks to the men who have done and will continue to do this work with no thought of reward except an opportunity to serve their country.

The nations of the world know what the United States is capable of doing if given a year to pull herself together; and when they realize that she is in a position to repeat this same performance in a matter of days instead of months, they will be less likely than ever to stir us up.

American industry wants peace above all else. Not a single important industrial organization now in existence gained the least benefit by the last war. On the contrary, all were injured. And it is because we believe that these plans for industrial defense form one of our most effective guarantees of peace that we heartily endorse them."

Defense Day Test Indorsed

NOW that National Defense Day has come and gone, the general feeling of the press seems to be that, after all, there was nothing in the occasion to alarm the most ardent antimilitarist or the most suspicious of the world's nations.

Echoes of political controversy may be noted in the discussion, but largely the comment is nonpartisan. The view of many edtiors thus is expressed by *The Birmingham News:* "All over the United States, sons and daughters of the republic rallied to the colors, but not in any spirit of braggadocio, nor could the most critical say that there was evidence of a military gesture in the test, or anything that would give to the rest of the world the idea that the United States has a chip upon its shoulder. Rather it was a wholesome exhibition of a peaceful nation that does not want to fight and does not propose to maintain a great standing army, but depends upon the patriotic cooperation of all the people as a matter of defense, if defense is necessary."

There is "no more military spirit in the nation today than there was a week ago, a month ago or a year ago," continues *The New York Evening Post,* which characterizes Defense Day as "a sober and thoughtful day, in which we held up to ourselves and examined the slender and admittedly inadequate military power of these United States."

As a demonstration, *The Oakland Tribune* considers "there is nothing in Defense Day to justify the great amount of discussion it provoked, but as a roll call and test it served a purpose." It was an assemblage, *The Salt Lake Deseret News* declares, that "gave undisputed evidence of a united people loathing war or the possibility of war, but manifesting a disposition to defend and maintain the standard of liberty whenever that standard is unjustly assailed."

Indeed, a "convincing proof of the loyalty and the patriotism of the American people" is the way *The Seattle Times* puts it. No theoretical pacifist, *The Washington Star* is sure "can find in that spectacle any token of danger to the established policy of this government to abstain from aggression and to avoid war, while standing always ready for self-protection."

The Omaha World Herald says: "In Omaha the people seemed to take the affair rather solemnly, and that perhaps is a better evidence of deep-seated patriotic feeling that a grat deal of flag waving and cheering."

If Defense Day makes us think, *The Newark News* believes "It's going to pay," because "it is just as apt to impress us with the seriousness of war as it is with its pomp and panoply. It is apt to remind us of the great fact that war of today is not a matter of professional armies, but of the uprooting of a whole nation in each and every one of its myriad activities. It may lead us one step farther on the path of learning to 'think internationally,' which in the changed world is one of the things we have got to do if we are going to maintain our peace and our position."

To this *The Indianapolis News* adds that the defense act of 1920 "is now definitely on record, for it has been tested and found to be productive of the degree of preparedness that ordinary prudence dictates."—*Seattle Times*, September 25, 1924.

General Drain Heads American Legion

GENERAL James A. Drain, of Washington, D. C., a charter member of the Army Ordnance Association, was elected National Commander of the American Legion, September 19, 1924, at the annual convention of the Legion at Saint Paul, Minn.

HARRIS & EWING

General Drain

Always an ardent worker in the cause of national defense and especially in the welfare of the ex-service man, General Drain is one of the best known and universally liked of the American officers of the World War. His activities in the Legion have materially aided the great work it has undertaken. He was formerly chairman of its Fourth District Rehabilitation Committee, which comprises Maryland, Virginia, West Virginia and the District of Columbia. He was also vice-president of the American Legion Weekly Publishing Corporation. From May, 1919, to December 31, 1920, he was Department Commander, and served as a member of the National Executive Committee and of the National Legislative Committee of the Legion during that period.

Born in Warren County, Ill., September 30, 1870, he later became a resident of the state of Washington and for 17 years was a member of the National Guard of that State serving from private to the rank of brigadier general. He became a resident of Washington, D. C., in 1908 and for a number of years was president of the National Rifle Association and also chairman of the National Guard Association executive committee. During the Spanish-American War he served as a Captain of Infantry, National Guard.

During the World War he served with distinction in the Ordnance Department, first as Ordnance Officer, First Division, A. E. F., and as Ordnance Officer with the Tank Corps. He served overseas from June, 1917, to May, 1919. For his meritorious services he was awarded the Distinguished Service Medal, the cross of the Legion of Honor, and the Cross of the King of Italy. He was the American member, Anglo-American Tank Commission.

We take the liberty of publishing herewith an extract from a letter from General Drain written to the Secretary, A. O. A., shortly after his recent election. If by so doing we offend the General, we apologize but insist so candid a statement deserves the widest publicity. The letter speaks for itself:

"I regret that it will be impossible for me to attend the Sixth Annual Meeting of the Army Ordnance Association at Aberdeen on October 3. My election September 19 in Saint Paul to be National Commander of the American Legion has involved complete attention to the affairs of the Legion. I have cut myself off from everything in professional and business life for the year which my term of office will cover. I feel this course justified because I was elected without pledge or promise on the platform: 'For God and country, without partisanship in politics, without intolerance in religion, a business administration for the Legion; in short, a demonstration through The American Legion in every day American life of precisely the spirit which moved us in the War,' and because I know The American Legion, soundly administered, is sure to become the strongest single influence for every righteous purpose synonoymous with the name of America. We are going to try to make it what it ought to be.

Of course, everything that has to do with the sound preparedness program tending to make the country fight to defend itself in war the Legion strongly approves of. The Army Ordnance Association, in my opinion, is one of the powerful agencies through which preparedness may be secured, of course, with particular reference to material.

I wish I could come, but I can not. I want you to know, however, that my heart is with you. I wish for you all a most successful meeting."

The Army Ordnance Association extends to General Drain its sincere wishes for a most successfu administration of this important office. The American Legion is a mighty influence in our Nation—an influence of the first magnitude in the attainment of broad American principlesof peace, harmony and good will. Under the efficient leadership of General Drain the Legion is certain to acheive its worthy aims.

Ordnance Demonstrations

By

R. L. MAXWELL

WHILE many readers of ARMY ORDNANCE have been fortunate enough to be present at one or more of the Annual Meetings of the Army Ordnance Association at the Aberdeen Proving Ground and witness the demonstrations of ordnance which have been the main features of those meetings, there are many more who have not had that opportunity and experience. This article will deal particularly with "home talent" ordnance demonstrations which have been or might be arranged by Ordnance officers with the facilities available at their regular stations. Discussion of "home talent" ordnance demonstrations with Ordnance officers serving under varying conditions have brought out the fact that Ordnance officers as a rule feel that they have not available the necessary personnel, matériel, and space to stage a demonstration of sufficient magnitude to be of interest to their possible audiences. It is believed, however, that if an Ordnance officer definitely plans to hold a demonstration of ordnance, that it will be possible for him to find the required personnel, matériel, and space to put on a creditable show. It is surprising how little material is really required and how available it actually becomes once the decision is made to hold a demonstration. The usual small detachment or company of ordnance personnel can, in most instances, be reinforced by details of Line officers and enlisted men to assist in the demonstration. The requirements for space can very often be adjusted to agree with the space available. The question may arise why hold a demonstration? What is to be gained by such demonstrations? It is believed that the answer is three-fold: aroused interest of other branches of the Army and civilians in arms and ammunition, training of Ordnance personnel in the characteristics of the matériel for which they are responsible, and a specific demonstration of the fact that the Ordnance Department is prepared to equip the Army with ordnance that functions.

Foreword

I have read this article on "Ordnance Demonstrations" with much interest and I feel sure that local demonstrations of Ordnance matériel arranged as suggested by Major Maxwell will result in interesting the Line of the Army in Ordnance weapons and their uses and possibilities as well as affording an excellent means of instruction for the personnel of Ordnance organizations participating therein. I desire to encourage such Ordnance demonstrations where it is practicable to hold them.

Major-General, Chief of Ordnance.

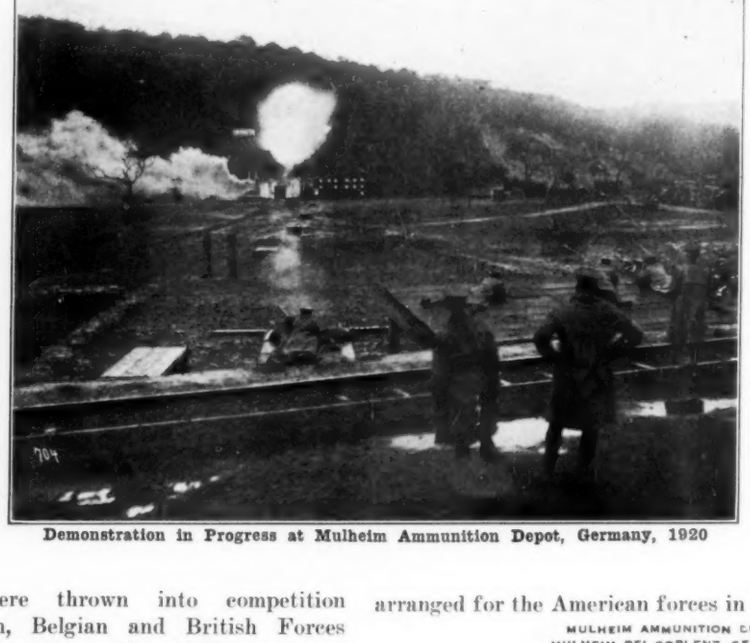
In general, it may be said that the demonstration consists of a display of arms, ammunition, and matériel that pertains to the maintenance of arms or facilities for the training of troops, a firing program, and a verbal explanation of the items displayed and their performance. As a rule, Ordnance officers will confine their demonstrations to showing the basic characteristics of the arms, ammunition, and other items of Ordnance equipment available and will not enter the field of the tactical uses of the weapons. In other words, they will attempt to show what the Ordnance Department *provides* for the Line of the Army to *use*, leaving to the Line the demonstration of *how* used. Having decided to hold a demonstration and prepared a plan in detail, it will be found very necessary to hold a dress rehearsal with as little audience as possible. It will be found also that during this rehearsal ideas will suggest themselves and that considerable improvement over the original plan can be made. Most demonstrations can be given regardless of weather, and once the audience arrives it is very important that the show begin promptly, proceed without interruption, and not last too long. Full advantage must be taken of all opportunities to make the demonstration spectacular in order to catch the interest of the audience at the beginning and hold it throughout the performance. The placing of the audience with reference to position of the sun, provision of seats, shelter and other means of making the audience comfortable, the use of a megaphone or other form of amplifier to transmit the verbal explanation to every person in the audience, are all points worth considering. Repetition of a demonstration on the same ground with the same matériel and personnel will invariably result in improvement, especially if the officer in charge asks for and acts upon suggestions of his assistants and members of his audience.

Having outlined, in a general way, "home talent" ordnance demonstrations, specific examples of

demonstrations conducted under widely different conditions will be discussed briefly.

In the American Forces in Germany

The American Forces in Germany were organized July, 1919, at the time of the break-up of the American Third Army and very soon dwindled to a force of some 10,000 troops, left on the Rhine to carry on the work begun by the Third Army which at one time consisted of something over 300,000 troops. The Forces were thrown into competition with the large French, Belgian and British Forces of Occupation, and it was the desire of all Americans in the Forces to maintain a high standard in all respects. The ammunition activities of the Forces were centered in the Ammunition Depot at Mulheim-Bei-Coblenz. This is an old pre-war German Ammunition Depot, and under the plan of the American Forces in Germany was to house all of the reserve stocks of ammunition for the American Forces in Germany. In order to train the Ordnance personnel engaged in ammunition work in the American Forces in Germany and at the same time furnish the entire personnel of the American Forces in Germany an opportunity to learn about ammunition, the Commanding Officer of the Ammunition Depot initiated a series of firing demonstrations beginning in December, 1920, and continuing until June, 1921. This series consisted of eighteen demonstrations and all concerned agreed that by this means a very appreciable amount of knowledge of Ordnance was gained by both the personnel engaged in giving the demonstrations and the eighteen audiences which witnessed them. In all, it was estimated that 500 officers, 200 Allied civilians and 1,000 enlisted men took advantage of them. These figures include all of the general officers of the American Forces in Germany and practically all officers of field grade of all branches of the Service on duty in the Forces. The comments of these visitors were very complimentary and the demonstrations were regarded by Headquarters as a distinct asset of the Forces. To the military members of the audiences the demonstrations were a welcome change from the customary ceremonies of review and parade, while to the civilians they provided an unusual opportunity to see behind scenes. The following memorandum taken from the files of the Ammunition Depot is a typical program of a demonstration as arranged for the American forces in Germany:



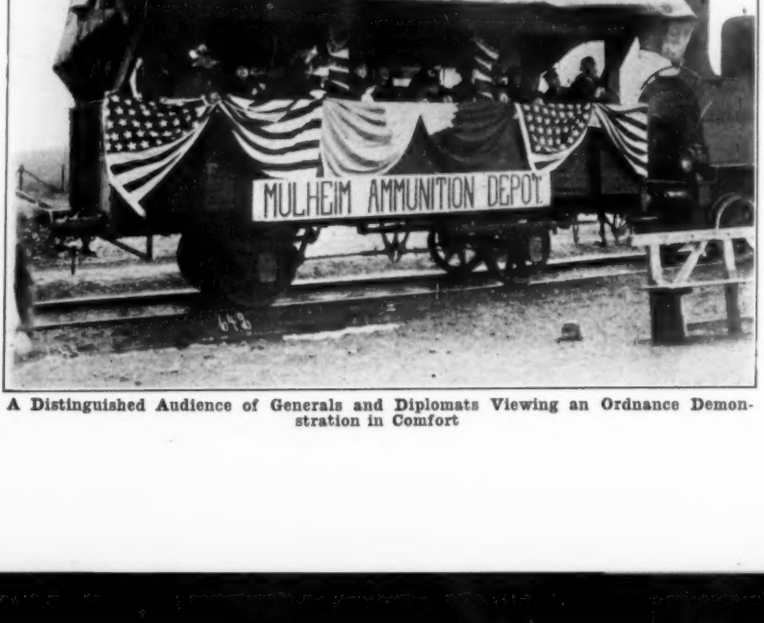
Demonstration in Progress at Mulheim Ammunition Depot, Germany, 1920

MULHEIM AMMUNITION DEPOT
MULHEIM BEI COBLENZ, GERMANY
15 JUNE, 1921.

MEMORANDUM NO. 51

1. The following order of events will be followed in carrying out the Demonstration at Proving Ground on 17 June, 1921:

(a) 75-mm. Field Gun (Shrapnel)---------- 1 round.
(b) 45 caliber pistol---------- 7 rounds.
(c) 30 caliber rifle (1) Blank. (2) Gal. Prac.-- 10 rounds.
(d) Automatic Rifle (1) Ball. (2) Armor-piercing. (3) Incendiary ---------- 60 rounds.
(e) Machine Gun (Tracer)---------- 20 rounds.
(f) Shotgun (No. 7½ shot)---------- 5 rounds.
(g) 37-mm Gun (Low Explosive Shell)------- 1 round.
(h) Hand Grenade in Box (Live)---------- 1 round.
(i) Hand Grenades:
  (1) O. F. Dummy (Practice Bouchon)-- 1 round.
  (2) F. I. Dummy (Live Bouchon)------ 1 round.
  (3) O. F. Live---------- 1 round.
  (4) F. I. Live---------- 1 round.
(j) Rifle Grenades:
  (1) V. B. Practice --1 round.
  (2) V. B. Live-- ------1 round.
  (3) No. 27 Phosphorus 1 round.
(k) Very Pistol (1) Red. (2) White. (3) Green 3 rounds.
(l) Smoke Candles ------ 2 rounds.
(m) Wing Tip Flares. (1) White (2) Red 2 rounds.
(n) Powder burning (ignited by slow burning fuze):
  (1) Black powder.
  (2) Trench Mortar Explosive.



A Distinguished Audience of Generals and Diplomats Viewing an Ordnance Demonstration in Comfort

(3) Smokeless Powder.
(4) TNT ignited by smokeless powder.
(o) TNT Explosion, ignited by slow burning fuze.
(p) Stokes Mortar (Dummy cartridge only)-- 1 round.
(q) Target Explosion (Infantry Combat Target) Ball cartridges.
(r) Stokes Mortar (Practice shell, cartridge and 1 ring)---------- 1 round.
(s) Stokes Mortar (Service shell, cartridge and 2 rings) ---------- 1 round.
(t) 37-mm. Shell (On ground) ---------- 1 round.
(u) 75-mm. Shrapnel (On post)---------- 1 round.
(v) 75-mm. Shrapnel (Lightly buried) ------ 1 round.
(w) 75-mm. Shell (Buried 24 inches) -------- 1 round.
(x) 75-mm. Shell (Buried 12 inches) -------- 1 round.
(y) 75-mm. Shell (On ground)---------- 1 round.

I. A. CRUMP,
Captain, Ordnance Dept.,
Commanding.

(d) The Browning automatic rifle fired service ball and armor-piercing and incendiary ammunition from the 75-yard platform.

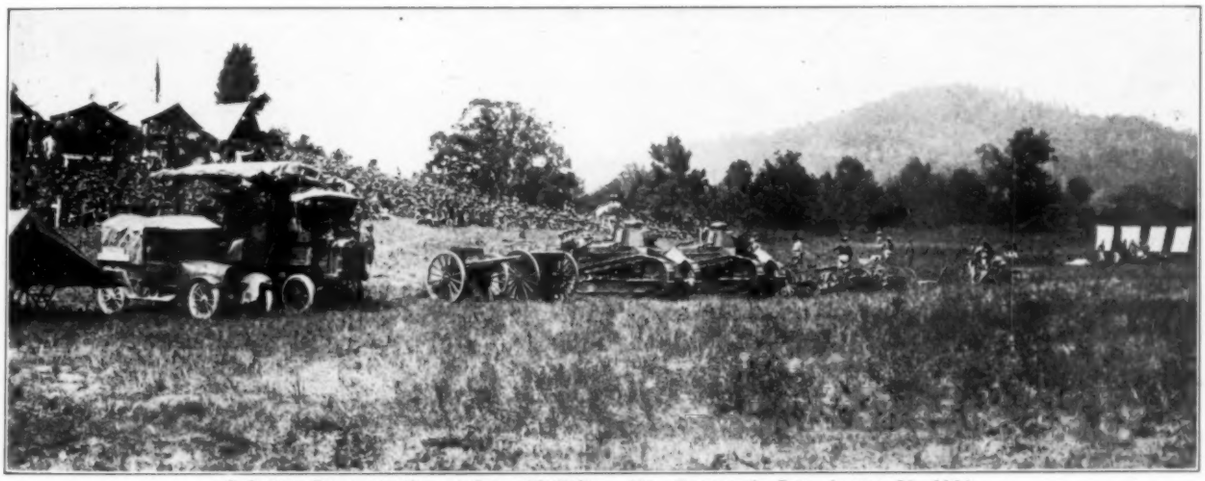
(e) The Browning machine gun fired tracer ammunition from the 100-yard platform.

The events (b) to (e) inclusive, produced a very effective climax that invariably caused a thrill. Explanation of each event accompanied firing and attention was called to distinguishing features of each.

(f) Shotgun was fired at clay pigeons thrown from traps located near the 100-yard platform and the gun shed.

(g) The 37-mm. gun was fired from the gun shed into the tunnel in the same manner as the 75-mm.

(h) This event consisted of firing electrically a loaded hand grenade in a fragmentation box, such as used for testing grenades and grenade filler. The grenade, with electric blasting cap in place, was enclosed in a small pasteboard box in the center of a five foot cubical box supported by four posts and elevated some five feet from the ground, the pasteboard box containing the grenade was surrounded with sand in which the fragments of the grenade were caught. Fragments were recovered by sifting the sand.



Ordnance Demonstration at Camp McClellan, Ala., Governor's Day, August 23, 1924

A brief description of the facilities provided and the methods used follows:

(a) A small gun shed with timber and earth sides and rear wall and ceiling (32 inches thick) was provided as an emplacement for the 75-mm. Field Gun (French). The gun was fired by a lanyard through a pipe set in wall and the projectile entered a tunnel in the side of a hill 100 yards distant. The tunnel was 5 feet wide, 5½ feet high and about 30 feet deep. Sides, built up of boxes filled with earth and ceiled with bridgeplank. The shrapnel set to burst on impact buried itself in sand at back of tunnel and burst without being heard. Smoke from the burst came out of mouth of tunnel several minutes later. The gun was laid on a paper target 8″ x 10″, with a 3-inch bulls-eye, suspended in centre of mouth of tunnel and the paper target was usually struck much to the surprise of the spectators. One Infantry field officer accused us of faking that part of the demonstration.

(b) A series of platforms, 25, 50, 75 and 100 yards from targets set in side of hill beside mouth of tunnel were provided for small arms fire and caliber 45 pistol was fired from 25-yard platform.

(c) The caliber 30, model 1903, rifle fired blank and gallery practice ammunition from the 50 yard platform.

(i) The series of grenades fired in this event were arranged on plank platforms a few feet apart on the side of the hill near the tunnel. Each grenade was fastened to a stake so that the lever could fly free when a wire substituted for the safety pin was pulled. The loaded grenades were fired behind boxes filled with earth to prevent spread of fragments in direction of the spectators. The wires were pulled by men standing inside mouth of tunnel.

(j) The rifle grenades were all fired with lanyard, the rifle being held in a stand inside the gun shed. The grenades burst on the hillside above tunnel. The phosphorous (English) grenade gave very spectacular effect.

(k) The Very pistol was fired from the 25-yard platform.

(l) Smoke candles were set on a stand near tunnel mouth.

(m) The wing tip flares were fired electrically and were fastened to ends of the stand on which smoke candles were burning.

(n) This event showed very well the difference between the burning of different explosives and propellants. Small amounts of salvage material being used in each

case. The quick puff of smoke from the black powder, the slow flame of the smokeless powder and the prolonged burning of the trench mortar shell filler and TNT with characteristic smoke of each served very well to show the difference between these materials.

(o) This event showed detonation of TNT to illustrate difference between burning and detonation.

(p) A dummy Stokes mortar shell was fired from the Stokes mortar in the gun shed using a special lanyard which permitted fire to be under cover.

(q) The target used was a sample of those made for use on Infantry combat ranges to represent machine gun nests. When struck with ball caliber 30 ammunition the target burned and then exploded producing a very spectacular effect.

Between (q) and (r) the spectators moved to a point from which they could observe the impact of the shell fired from the Stokes mortar in the gun shed. (p), (r), and (s) showed the increases in range obtained by adding increment rings to the propellant cartridge.

ation and conduct of the demonstrations. It was found however, that the entire 60th Ordnance Company took an active interest in making the shows a success and the effect on the morale of the organization was very conspicuous. It was found also that officers of all grades in the Forces, including the General Officers, did not hesitate to call upon the Commanding Officer of the Ammunition Depot for special demonstrations of the various weapons with which the Forces were armed. For example, a Brigade Commander asked for and was given a special firing demonstration of 3-inch Stokes Mortar which furnished him the detailed information which he desired relative to that weapon, the ammunition available for it, and the results from a technical standpoint that could be obained by firing the various combinations of propellant and fuze that were possible with the ammunition provided. The Chief of Staff of the Forces remarked that these demonstrations had put the Ordnance Department on the map, while many other persons stated, after seeing the demonstration, that they had seen for the

Chaplain McNally and his Megaphone Transmitting Explanations at Camp McClellan Demonstrations

(r) The practice shell consisted of a sand-loaded shell with a black powder cartridge in booster seat and a service fuze. This combination facilitated observation of firing.

(s) The live Stokes mortar shell gave the heaviest explosion on the program.

(t) to (y) were fired electrically by a man in a dugout on a hillside 600 yards away and the effect was similar in each case to results obtained by actual firings.

(t) 37-mm. shell (low explosive) used for this test.

(u) This event showed an air burst of a 75-mm. shrapnel.

(v) This simulated graze burst of shrapnel.

(w) This gave some idea of the effect of a long delay fuzed shell which did not ricochet and which had penetrated the ground.

(x) Similar to (w) but short delay.

(y) A super-quick fuzed shell bursting on surface of ground.

Mr. G. C. Hale, Ordnance Department, (at present Chief Chemist, Picatinny Arsenal) as Chief of the Technical Division of the Ammunition Depot, and 1st Sgt. W. A. Mack, 60th Ordnance Company, deserve credit for the succesfsul working out of the details of the install-

first time many of the items shown, knowing at the time what they were seeing.

To sum up the results of the series of demonstrations at the Ammunition Depot of the American Forces in Germany, it may be said that the personnel of the 60th Ordnance Company obtained needed and valuable experience in the study and actual firing of the types of ammunition available to the American Forces in Germany, while personnel of other branches of the Army actually saw the ammunition available for them to use functioning in the weapons with which they were armed. The amount of material consumed was comparatively small. The space used in the demonstrations was not greater than that obtainable in practically any regular post or station of the Army. An appreciable number of officers, enlisted men and civilians were given a favorable impression of the Ordnance Department.

Summer Training Camps, Camp McClellan, Alabama

During the period of the Summer Training Camps at Camp McClellan, Alabama, during the summers 1923 and 1924, there were present a number of officers and enlisted men who had seen the demonstrations described above in Germany, and a demand gradually developed for

similar demonstrations at the Camp for the benefit of trianees of all categories. The Camp trained large contingents of Reserve Officers, R. O. T. C. and C. M. T. C. trainees, Regular Army troops and National Guard troops of several branches. A series of demonstrations was finally arranged for the 1924 Camp beginning with small demonstrations for Reserve Officers and ending with a demonstration of the Ordnance of an Infantry Division on Governor's Day, August 23, 1924, just prior to the close of the National Guard Camp. These demonstrations included a display of arms, ammunition, targets and maintenance equipment pertaining to the following weapons: 75-mm. field gun, light tanks armed with 37-mm. gun and caliber .30 machine gun, 37-mm. gun, 3-inch trench mortar, machine guns, automatic rifles, rifles, pistols, grenades, pyrotechnics.

All weapons were fired with the available types of ammunition during the demonstrations and a limited explanation and description of the characteristics of each type of weapon and each type of ammunition was given. The training value of these demonstrations was favorably commented upon by experienced officers of all branches. Some of the points which came up in connection with these demonstrations are worth mentioning. The space available for these demonsrtations was sufficient to permit firing at ranges up to 7500 yards. The demonstration was arranged close to the base of a hill which made a natural amphitheater for the audience. The officer conducting the demonstration transmitted his verbal explanations by means of the best voice in Camp through megaphone to the audience. This voice happened to be possessed by Chaplain E. T. McNalley of the 8th U. S. Infantry, who was well and popularly known in the Camp for his ability to use the megaphone. The use of the popular chaplain in these demonstrations contributed a great deal to their success. Everybody could hear as well as see what was going on. The troops used to put on the shows came from the several Regular regiments on duty at the Camp.

At the demonstrations given for the Reserve Officers, the officers themselves were given an opportunity to personally fire the various weapons after the regular show was over. The demonstration given on Visitor's Day of the R. O. T. C. and C. M. T. C. Camps preceded the tactical demonstration given by the R. O. T. C. Camp which consisted of a demonstration of the infantry battalion in attack. The demonstration given on Governor's Day of the National Guard Camp was the only Regular Army activity on Governor's Day. These demonstrations at Camp McClellan would not have been possible without the cooperation and assistance of the Camp Headquarters Command and Staff and the enthusiastic and efficient support furnished by Line organizations, especially the 8th Infantry, this regiment having turned over without reservation its entire personnel for use, if needed, to put on the demonstration, while similar assistance was furnished by the 22nd Infantry, the 4th Tank Co., and the 83rd Field Artillery.

In conclusion, it may be said that Ordnance officers of organizations and stations can do a great deal toward assisting in the dissemination of Ordnance information by means of demonstrations which they personally organize and conduct. The matériel necessary is available at the station or can be made available with very little effort or expense. The personnel can be made available provided the cooperation and interest of local commanders are obtained. The space and facilities necessary for a demonstration can be found if really sought for, and those who cannot plan, organize or conduct a demonstration can participate to the extent of being the audience, which after all, is the most important part of any show.

Col. Edward S. Ready

COL. EDWARD S. READY, a charter member of the Army Ordnance Association and a prominent reserve officer of the St. Louis Ordnance District, died at his home, Helena, Arkansas, September 22, 1924.

At the time of his death, Colonel Ready was president of the Inter-State National Bank of Helena and of the New South Oil Mill and also a director of the Missouri State Life Insurance Company. He was a past President of the Inter-state Cotton Seed Crushers Association and a member of many civic and fraternal societies.

Appointed a major of Ordnance, October 22, 1918, he was made a lieutenant colonel, July 22, 1919. During the War and until his return to civil life July 7, 1920, he served on the staff of Mr. M. E. Singleton, Chief of the Saint Louis Ordnance District, where he did much to help make that district the efficient and productive organization that it was.

In his passing his many friends have lost a man of splendid citizenship and high attainments. An appreciation of Colonel Ready's excellent service during the War and of his noble personal characteristics was well summarized by one of his friends, Major Thomas J. Johnson of the General Staff, when told of his death:

"Colonel Ready was certainly a wonderful man. I know of no one who impressed me more or for whom I had a deeper respect. I can appreciate some of the troubles he ran into during the War. And when the Armistice came and he was kept on and on when he should have been back in his own business he did not complain but went on with his work. When a man his age came to the help of the Government and worked as he did, we all knew that the country was safe. There is not enough credit to him."

The news of his passing was a great shock to all who knew him. Colonel Ready was a man who endeared himself to all with whom he came in contact. He was the embodiment of the typical Southern spirit, big hearted, generous to a fault, always willing to aid the unfortunate. His loss to the Saint Louis Ordnance District and to the Army Ordnance Association is great.

Ordnance at the National Matches

By

J. S. HATCHER

FOR many years the rifle shooting fraternity has formed the principal liaison between the Army Ordnance Department and the average American citizen. The high point of this contact between the Ordnance Department and the man in the street comes annually at the rifle shooting classic called "The National Matches," which is attended by several thousand citizens, both military and civilian, from all branches of the Service and from all walks of life.

The Ordnance Department is brought sharply to the attention of this group principally because it furnishes them the rifles and the ammunition for their competitions, and it is to the Ordnance Department that they must appeal for help in case of difficulty, and for the carrying out of suggested improvements.

A reflection of this is found in the fact that most National Guard Ordnance Officers of high rank attain their office through being prominent rifle shots.

The agencies that handle the subject of marksmanship in the United States are as follows:

The National Board for the Promotion of Rifle Practice, which is under the direct supervision of the Assistant Secretary of War, who is Chairman and President of the Board. Through the activities of this board the interests of the military and civilian riflemen are served, and the activities of all riflemen coordinated so as to assure the continued healthy growth of small arms rifle practice as a national institution.

The object of the board is to further interest in rifle and pistol marksmanship among the citizenry of the United States at large in the interest of the national defense.

The National Board handles the development of military marksmanship both in and out of the Services. Under the National Board there is a War Department officer detailed as Director of Civilian Marksmanship. His duty is to aid the civilian clubs and individuals who are interested in marksmanship of a military type.

Another powerful agency working to the same end is an organization of riflemen and pistol shots banded together into an association for the furtherance of the interests of shooting of all kinds. This organization is called the National Rifle Association of America, and was incorporated in 1871. Since that time it has carried on its roll as active members and officers the best known target riflemen developed in this country. Today, however, it is far more than a target shooters' organization. It has reached the status of a national fraternity of American citizens believing in the furtherance of rifle shooting as a splendid sport and a measure of national defense.

In the latter capacity, the National Rifle Association has been recognized as a medium through which is conducted the promotion and organization work of the National Board for the Promotion of Rifle Practice. By reason of this recognition, the National Rifle Association works in close cooperation with the War Department.

This Association has a large and rapidly growing membership scattered in every part of the country, and has been a powerful factor in securing legislation which has enabled the Ordnance Department to make advances in arms and ammunition which would not otherwise have been possible.

The National Matches

Each year the War Department holds a competition known as The National Rifle Matches, which includes a National Individual Rifle Match, and a National Individual Pistol Match, open to any citizen of the United States; and a National Rifle Team Match, and a National Pistol Team Match, open to civilian or military teams.

At the same time that these matches are held, the National Rifle Association of America holds a series of historic matches with rifles, pistols and revolvers.

In past years these matches have been held in various parts of the United States. The last four matches have been held at Camp Perry, Ohio, which has been the scene of twelve of these matches altogether.

Camp Perry is the Ohio State Rifle Range located on the shore of Lake Erie about half way between Cleveland and Detroit. It is one of the finest and best equipped rifle ranges in the world. There are at Camp Perry:

50 pistol targets,
66 rifle targets at 200 yards,
97 rifle targets at 600 yards,
50 rifle targets at 800 yards,
50 rifle targets at 900 yards,
50 rifle targets at 1,000 yards.

The long range targets can be combined so as to give one hundred (100) targets at 1,000 yards.

The direction of firing is north, and the bullets fall into Lake Erie.

Owing to the increasing popularity of the National Matches in recent years, the number of competitors has been increasing steadily so that at the present time steps are being taken to enlarge the firing facilities at Camp Perry beyond even their present magnificent proportions.

The World War brought sharply to the attention of the authorities the fact that proficiency in rifle shooting is one of the most powerful assets for national defense, and since that time the National Matches have been preceded by a Small Arms Firing School. This has become perhaps the most successful and beneficial feature of the matches. The school was operated this year under the direction of Lt. Col. Smith W. Brookhart, ORC., President of the National Rifle Association, assisted by a corps of the most competent instructors, headed by Captain F. G. Bonham, Infantry, Senior Instructor.

Attendance at the Small Arms Firing School is not compulsory upon National Guard teams or civilians attending the matches at their own expense. All members of the National Guard, and all unattached individuals, are, however, cordially invited to attend the school. This affords additional practice and splendid instruction.

Any citizen of the United States is eligible for enrollment in the school, and those who qualify are graduated with certificates as instructors in pistol marksmanship. The body of graduates of this school will form a most valuable asset to the national defense in case of an emergency.

At the National Matches it is the privilege of any American citizen who desires to do so, to go through the school without any expense to himself, except for his meals, and of course transportation to and from Camp Perry.

It is impressed upon the citizens that they are not expected to be good shots in order to attend this course of instruction. The school is conducted for people who are not expert shots, but who want to learn. The man who is generally interested in the use of firearms, but who lacks practical and technical experience, is considered the very best material for training at the school.

The School of Instruction began this year on August 30th, for students of the R. O. T. C. and C. M. T. C., and any unattached civilians desiring to attend. For regularly organized civilian teams, and for National Guard Teams, the school opened on September 6th. After a most successful course, the school closed on Saturday, September 13.

The N. R. A. Matches opened on September 15, and continued through until the beginning of the National Individual and National Team Matches.

The attendance at Camp Perry this year included in round numbers over twenty-two hundred competitors. It has been thought in the past that the value of these competitions in diffusing a knowledge of marksmanship through the country was somewhat impaired by the possibility that the same crowd of shooters would attend the Camp Perry Matches over and over, and the training would therefore be wasted on people who already knew how to shoot. This year careful statistics were taken with a view to determining the condition in this regard, and to the surprise of even the officials who have run these Matches for several years, it was found that the proportion of absolutely new material was approximately 85 per cent of the total number of contestants.

Test of New Developments

One feature of the National Matches which has not been realized in many quarters, is the fact that these series of competitions has, since the World War, furnished a most valuable service test of new developments in arms and ammunition made by the Ordnance Department in response to the lessons of the World War.

During the War it was plainly seen that our 150-grain service type of small arms ammunition was capable of tremendous improvement. This bullet was sharp pointed, with a flat base, and was covered on the outside with cupro-nickel. It was found that this cupro-nickel would collect in lumps on the bore of the rifle, and would therefore cause inaccuracy. It was also found that owing to the square-base shape of the bullet, the range was not as great as could be obtained by refinements in shape.

Immediately after the War, the Ordnance Department started a series of intensive experiments to overcome both of these defects. Before the change in shape had been fully worked out, experiments at Frankford Arsenal indicated that the metal fouling could be done away with by using a powder containing a decopperizing alloy. All the Arsenal firings with this ammunition were highly successful, and it was placed in the National Matches for that year.

The ammunition was found to be quite accurate, so that many records were broken. It was soon found, however, that many contestants complained of a black sooty deposit in the bore of the guns, which could not be removed with any amount of scrubbing with clean rags. An investigation showed that this was a deposit of the non-fouling alloy which was volatilized when the powder was fired, and was later deposited on the bore.

This deposit was easily removed by means of a brass cleaning brush, and owing to the fact that guns are thoroughly and properly cleaned after each firing at the Arsenal, this condition was not discovered in the Arsenal firings.

However, at Camp Perry there are fired approximately one and one-half million rounds of ammunition each year, and it is fired by people from every walk of life. There are experienced military riflemen on the Service Teams, whose technical knowledge is a great assistance in discovering defects and recommending changes. There are also the absolutely inexperienced civilians, some of whom will make the mistakes which would be found in a large army of citizen soldiers, and their troubles are carefully studied by the Ordnance Department in an effort to make the ammunition "fool proof."

The Ordnance Department has keenly realized the advantage of the National Matches as a service test of ammunition, and has had technical observers on the ground each year to follow the performance of the ammunition most carefully, with a view to energetic action in correcting any defects that may occur, and in making improvements.

In view of the trouble which occurred with non-fouling powder in 1920, the Ordnance Department, in 1921, placed on the firing line at Camp Perry a bullet the jacket of which was covered with a non-fouling alloy. This ammunition worked well at the Arsenal, and at Camp Perry was found to be a still greater improvement in accuracy than the 1920 ammunition, but a number of contestants used grease on the neck of the cartridge, which prevented the neck from readily expanding under the powder pressure, and it was found that under these conditions the surface of the bullet which was roughened by plating with the non-fouling alloy, had a tendency to sieze in the brass neck of the cartridge and cause erratic pressures, so that some trouble was encountered with swelled head cartridges, due to high pressure from using grease.

Experience at the National Matches during this period also confirmed the observation that cartridge cases annealed soft enough to be satisfactory for use in machine guns, caused excessive difficulty in extraction during rapid fire. In view of this fact, the Ordnance Department developed an improved rifle cartridge case anneal, which permits the cartridge case to be extracted with extreme ease under all conditions of rifle shooting.

With the bullets as used in the 1920 and 1921 National Matches, the extreme range with the rifle elevated to around 30 degrees was approximately 3300 yards.

Boat-tailed Bullet

The next year, 1922, saw the introduction by the Ordnance Department for the National Matches of a bullet with a tapered base. The weight of this bullet was increased to 170 grains, and the taper on the base was 6 degrees. This bullet was found to have a miximum range approximately 1300 yards greater than the former bullet with the same initial velocity. This increase in range was due to the fact that the tapered tail reduced the drag of the air on the rapidly moving bullet. Of course it will be understood that this increased range *as such* is of no value to the rifleman, although it is to the machine gunner. However, this ammunition did have a great advantage for the rifleman, in that the lessened drag on the bullet allowed it to reach the 1,000 yard target much more quickly than did the old bullet which started out with the same range.

The Department was very much gratified to find from the results at Camp Perry that the new 6-degree bullet was more accurate than the previous ammunition, and so this 6-degree boat-tailed cartridge was continued for the National Matches of 1923, where it produced extreme satisfaction on account of its very much increased accuracy over previous types of bullets. However, in the meantime the Ordnance Department in seeking a new type of ammunition to be adopted for the service when the present war time supply of 150-grain bullets is exhausted, found that a still further decrease in air resistance could be obtained by making a 9-degree taper on the bullet instead of a 6-degree taper. A series of proving ground firings with a number of bullets of various shapes and degrees of taper, lead to the use for the 1924 National Matches of a 9-degree boat-tailed bullet which had an increase in range over the 6-degree bullet which was almost as great as the 6-degree had over the old 150-grain bullet.

The new bullet will go approximately 5900 yards at maximum elevation, as against 4700 yards for the 6-degree advantage the 6-degree had over the old 150-grain bullet.

The practical effect of this is seen in the fact that if the rifleman should target his rifle on the 1000 yard target with the old 150-grain type of bullet so that he would hit the bull's-eye, and would then put in one of the new cartridges with the same velocity his bullet would go nearly 10 feet over the target. This is owing to the fact that the lessened air resistance allows it to get down to the 1000 yard target before it has dropped as much as the old bullet did. In other words, its trajectory is flatter, and consequently its danger space is much increased, which makes a very much more effective bullet for military uses.

Another marked improvement is that the new bullet is not affected as much by wind as the old bullet was, because the wind does not have as long to act on it owing to the fact that it gets down to the 1,000 yard range quicker.

In spite of the fact that the Ordnance Department test showed this bullet to be superior to the former types, the verdict of the rank and file of National Match shots was awaited with anxiety. This year the Ordnance observers at the matches were highly gratified to have extremely satisfactory reports from all sources on the performance of this bullet. The testimony of the various teams and individuals showed conclusively that this bullet has a marked superiority over previous types, especially in long range shooting, on account of its lessened angle of elevation, reduced time of flight, and smaller wind correction.

National Match Rifles

While the greatest field of improvement since the War has been in the ammunition, the National Matches also serve as a service test for any changes that may be made in the arms. Since the War the attention of the Ordnance Department in small arms lines has been focused on obtaining a satisfactory semi-automatic shoulder rifle and therefore only minor changes have been tried out on the Springfield rifle.

There has, however, been developed by Springfield Armory a .22 caliber rifle for training in marksmanship which is becoming a favorite through its performance at the Matches. This rifle is available only to members of the National Rifle Association, and to those in the service, as it cannot be sold to the public at large without coming into competition with commercial makers of .22 Caliber rifles. The fact that commercial rifles are on hand at Camp Perry and can be purchased by individuals for about the same price as the Government rifle can, means that if the commercial rifles show marked superiority, those small bore rifle shots who are in the service, and therefore entitled to buy the Government rifle, will purchase instead the commercial product. In the face of this competition, the new .22 Springfield showed up exceptionally well in the small bore matches this year.

The small bore classic is the Dewar Match, shot annually between Great Britain and the United States. This year this match was shot by the American Team on September 28th at Camp Perry under very bad weather conditions. The American Team won the match, and the high score was made with a Springfield .22, which formed a spectacular climax to the already highly gratifying performance of the Ordnance matériel at this year's matches.

U. S. Chemical Warfare Service Association Formed

AT a meeting presided over by Brig. Gen. Amos A. Fries, Chief of Chemical Warfare Service, held in Washington on October 9, plans were perfected for the organization of the United States Chemical Warfare Association.

The purpose of this organization is to promote the efficiency of the National Defense by maintaining the high standards of the Chemical Warfare branch of the military establishment, by fostering *esprit de corps*, by the dissemination of professional knowledge, by the exchange of ideas and by placing the Chemical Warfare Service to the forefront of the military service through fostering and maintaining close contact between the chemists and chemical industry of the country and the Service.

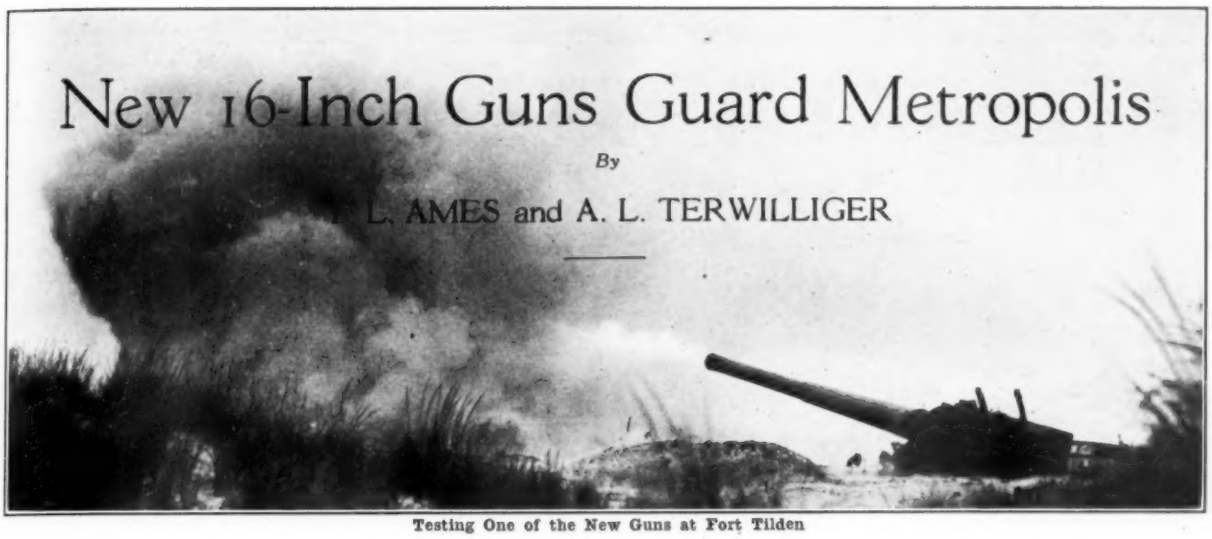
In carrying out this purpose it is understood that the Association will be guided by the broad principle that the interests of the Chemical Warfare Service are the interests of the Army, and the constant aim will be the upbuilding of the military policy of the country.

Capt. Frank B. Gorin, Chemical Warfare Officers' Reserve Corps, and until recently connected with the Chemical Division of the Department of Commerce as a dyestuffs expert, was elected National Secretary of the Association.

New 16-Inch Guns Guard Metropolis

By

L. AMES and A. L. TERWILLIGER



Testing One of the New Guns at Fort Tilden

TO provide greater protection for the entrance of New York Harbor between Long Island and Sandy Hook, and to prevent hostile ships from approaching within striking distance of Brooklyn, two 50-caliber, 16-inch guns have been emplaced on Barbette carriages at Fort Tilden, N. Y. The maximum range of these guns using the 2340-lb. projectile is about thirty-one miles. The projectile has sufficient remaining velocity at all ranges to penetrate 14 inches of the best armor. Mounting of these guns has been in progress for some time and they were proof-fired on September 18 and 19, 1924.

The 16-inch Gun, Model of 1919 MII, manufactured at Watervliet Arsenal, is of wire-wound construction composed of two principal tubes—A, the inner, and B, the tube next to it—extending the full length of the gun. In assembling, the jacket tube is shrunk on the B tube at the rear, a locking ring at the rear end of the jacket, and the P ring at the muzzle end of the B tube. Over this unit between the locking ring at one end and the P ring at the other, layers of wire are wound, more layers at the breech than at the muzzle. The wire is one-tenth of an inch square and wound at a tension equal to 50,000 lbs. per square inch. A series of hoops are then shrunk over this wire and this entire unit is heated and shrunk over the tube A, compressing it to its elastic limit. All of the hoops, tube and locking rings assembled by shrinkage are under a tension but not to their elastic limit. This construction permits the inner tube to be quite easily replaced when worn out through use. The powder chamber is cylindrical with a maximum diameter of 22 inches, an approximate length of 121.25 inches and a capacity of 40,000 cubic inches. The bore has 144 grooves 0.2091-inch in width, and a depth of 0.12-inch. The lands have a width of 0.14-inch.

It is approximately 70 feet long. The droop when at zero elevation measured from the front of the cradle to the muzzle, is about 0.4-inch. When firing, the muzzle vibrates about 3 inches.

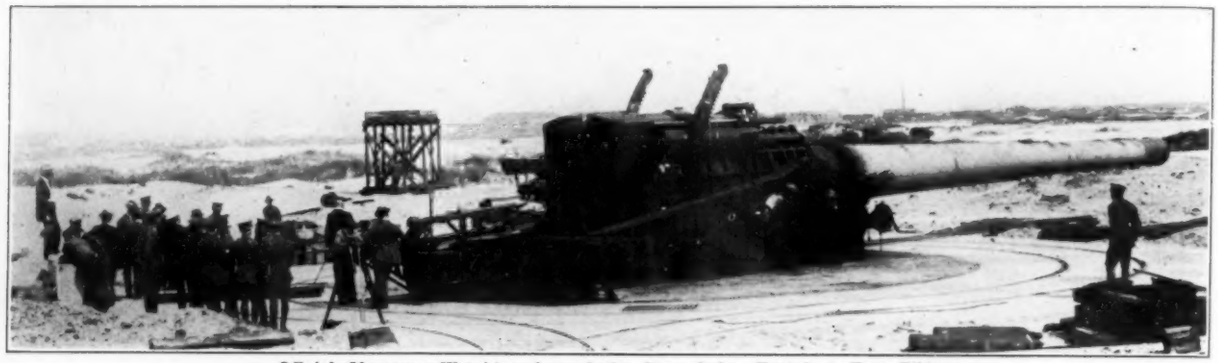
It is equipped with a breech block, supported by a carrier, or hinge on which it swings back and down. It is opened by hand and may be closed by hand or by compressed air. The breech mechanism is of the Welin step thread type, the circumference being divided into sixteen (16) segments machined to four diameters, four of which, the smallest, are unthreaded. This type of block has the advantage of requiring only one-sixteenth rotation of its axis to close or open. The compressed air for operation of the breech and the ejection of gases from the bore of the gun after firing is supplied by an air compressor operated by an electric motor of 30 h. p. capacity located in a compartment attached to the under surface of the racer of the carriage. The storage tank pressure is about 150 lbs. per square inch, which pressure is lowered by a reducing valve for the operation of the breech only to 85 lbs. per square inch.

The model of 1919 carriage, manufactured at Watertown Arsenal, is designed to permit the gun to be traversed through 360 degrees, elevated to 65 degrees and depressed to 7 degrees.

The emplacement is a concrete block without parapet and provided with anchor bolts for holding down the base ring. The depth of the emplacement from the loading platform to the bottom of the well is 16 feet. The diameter at the bottom is 13 feet 6 inches, at bottom of base ring, 23 feet 8 inches, and at top of racer, 38 feet 11 inches.

The racer rests and is rotated upon a circle of 42 live, conical, traversing rollers of forged steel, running on the lower roller path of the base ring. These rollers are separated by a cast steel distance ring and are held concentric by flanges on the inner ends of the rollers. The base ring sustains the weight of the carriage above the roller path, approximately 800,000 pounds. The total weight sustained by the foundation is approximately 1,000,000 pounds. The cradle, which forms a sleeve for the gun during recoil, is supported on the side frames by means of trunnions. Its weight is 120,000 pounds and with gun and recoil band weighs 500,000 pounds. The counterweight, or recoil band as it is called, is slipped over and attached to the breech end of the gun, thus permitting the mounting of the gun in the cradle with the breech materially closer to the trunnions than could otherwise be done. The size and weight of the counterweight involves a consideration of the total weight of tipping parts in the trunnion bearing as against the desired length of recoil in terms of stresses involved and diameter of the base ring. The weight of the recoil band, filled with lead, is approximately 60,000 lbs.

The gun is moved in elevation by circular racks attached to right and left side of cradle. Two pinions mesh with the racks. These pinions are connected through gearing to elevating hand wheels and also to an electric motor and hydraulic speed gear which permits the gun to be set in elevation by power. The hydraulic gear allows the gun to be laid quickly at any



Official Observers Watching One of the Guns Being Tested at Fort Tilden

elevation between extreme limits of minus 7° and plus 65°. A brake drum is provided on one of the gears insuring proper control.

An anti-friction device is provided which lifts the dead load of the gun and cradle from the main trunnion bearings and provides a roller bearing. During firing, this device allows the main trunnions to come into bearing. When the firing stresses cease, Bellville springs lift a lever and the dead load is again carried by the roller bearing.

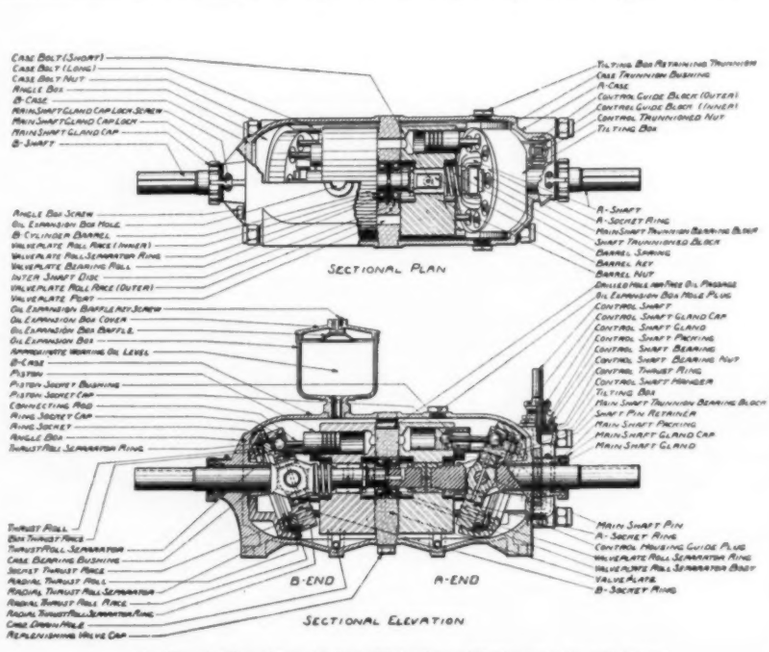
Attached to the cradle on either side are stops bearing against the recoil band or counterweight, which fix the position of the gun in the firing or in battery position. The length of these stops is so fixed that with the gun horizontal, in battery, and loaded, it will have a breech preponderance equal to one-half the shot and charge, or if unloaded in this position an equal muzzle preponderance. Thus adjusted when loaded the breech preponderance is sufficient to bring the gun to any desired elevation if the brake band is released and similarly after firing the muzzle preponderance will bring the gun to the loading angle of 4°.

The recoil and counter-recoil mechanism consists of two long and two short cylinders and two recuperator cylinders, together with their pistons and rods. It should be noted that these mechanisms are arranged in pairs symmetrically about the gun; that is, the two short cylinders are opposite each other, one at the upper left and the other at the lower right, the double length cylinders are at the upper right and lower left, and the recuperators directly above and below the gun. The advantage of such an arrangement is obvious. The short recoil cylinders function during recoil only, whereas the long recoil cylinders and recuperator cylinders act both during recoil and counter-recoil.

The total piston rod pull, when the gun is fired at 65° elevation, is approximately 1,600,000 pounds, which, with 40-inches recoil, gives approximately 5,300,000 foot-pounds of energy dissipated.

The liquid used in the recoil cylinders as well as in the front end of recuperator cylinders is a solution of equal parts of glycerine and water. Compressed air in the recuperators acts to hold the gun in battery.

The action of the carriage is as follows: when firing, the gun recoils in the cradle a normal distance of from 30 to 40 inches with a possible maximum distance of 42 inches. The energy of recoil is absorbed in the four recoil cylinders and by compressing the air in the recuperator cylinders from an initial pressure of 1750 to about 3140 pounds. The velocity of counter-recoil is controlled by the piston and grooves in the forward ends of the long recoil cylinder. This piston has valves which open in recoil, permitting the free passage of the liquid but which close in counter-recoil. As the elevation increases, the weight of the gun becomes a greater factor in reducing the velocity of counter-recoil. The pressure and therefore the resistance to counter-recoil increases and decreases with the velocity of counter-recoil. The system is thus automatic over wide angles of elevation and controls the gun so that it moves slowly and smoothly into battery at all angles of elevation.



Sectional Elevation of the Waterbury Hydraulic Speed Gear

This special provision is necessary because of the wide variation in power required to return the gun to battery between zero degrees and 65 degrees elevation.

A power rammer is located on the racer near the breech of gun for ramming the projectile and powder. It is operated by hand cranks or by electric motor and speed gear.

The projectile car holds three projectiles, and is hauled by a 3-ton F. W. D. truck, modified for railroad use, from the magazine, which

is at a distance from the gun, on a standard gauge track, and switched over a circular track around the carriage to the revolving shell table at the right and the rear of the breech. This table, with the projectiles upon it, is then revolved until the axes of projectiles are parallel to the bore of the gun. They are then rolled to the parking table, which is located between the revolving shell table and the rammer. One of them is then released from parking table and rolled on tray immediately in front of power rammer, and with the rammer is pushed to its seat in gun. The powder car carries 12 sections or 3 charges. Two sections are transferred to loading table and rammed at a time.

The gun is loaded at an angle of plus 4 degrees. After loading, the breech is closed, electric primer inserted in firing mechanism and one end of wire cable is attached to its mechanism; the other end is connected to magneto located some distance from gun, which is then ready for firing.

Power is provided for traversing, elevating, depressing, and ramming projectile and powder charge. As in all of these cases a wide variation in speed is needed, including slow motion, as these are required in both directions, it has been applied through the Waterbury Hydraulic Speed Gear.

This gear consists of an hydraulic pump operated by an electric motor, which delivers oil under pressure to an hydraulic engine which drives the traversing, elevating or ramming mechanisms. The speed of the hydraulic engine is determined by the rate at which oil is supplied to it and this is governed by the length of stroke of the pistons in the pump cylinders. This in turn is changed at will between zero and a maximum in either direction through the control hand wheels on the carriage. The pump (A end) and the engine (B end) may be contained within the same housing, the parts rotating about axes in the same straight line but not connected, or the A end and B end may be located at a distance from each other with the rotating axes at any angle, the two ends being joined by suitable connecting pipes. From the A end projects a shaft which drives the pump within, and is connected to the electric motor shaft which runs at constant speed in one direction only. From the B end projects a shaft, which is connected to the mechanism to be operated, driven at variable speeds in both directions by the hydraulic engine within. This device is admirably adapted to the purpose for which it is used on this carriage. A 7½-horsepower motor is used with it for traversing, a 50-horsepower for elevating, and a 30-horsepower motor for ramming projectiles.

The work of mounting these guns and carriages approached completion in midsummer and their test was set for September 15. As that date approached, it seemed likely at times that unforeseen delays would prevent carrying out the schedule. However, Watertown Arsenal, with fine cooperation, hurried forward the last shipments of parts required, and Wednesday, September 17, was chosen for the test. It rained all day Wednesday. Three shots were fired Thursday afternoon and the remaining nine Friday.

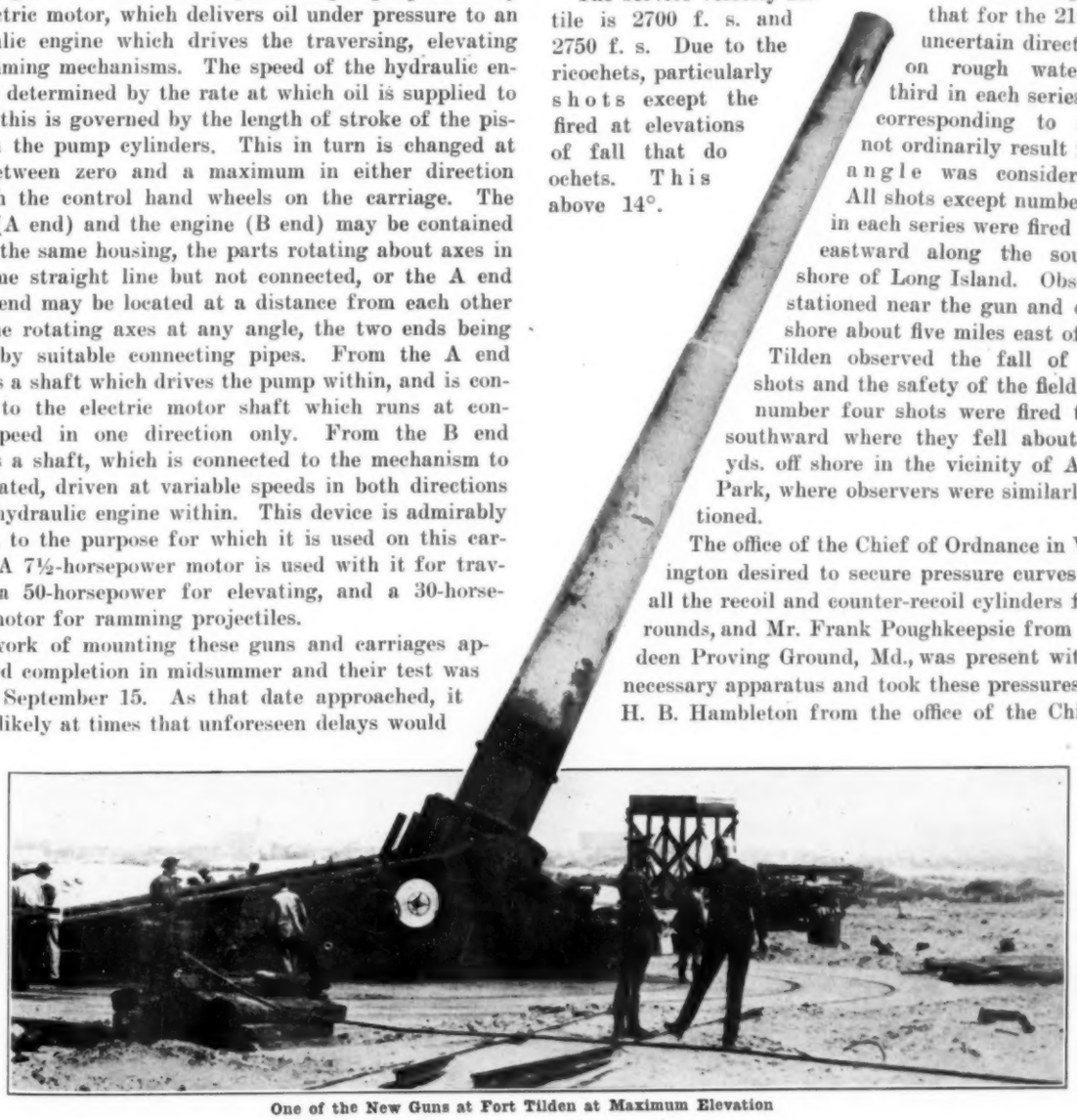
The cleaning of the guns was found quite a difficult process due to the time the preserving material had covered the bore. Paper and oil were burned in the bore to soften this coating and after much effort the guns were cleaned sufficiently to be satisfactorily star-gauged.

Another matter requiring attention in connection with the firing was the observation and safety of the field of fire. General Johnson Hagood, the Artillery District Commander, and Colonel E. B. Martindale, the Coast Defense Commander, lent every assistance possible, including the gun crew, observers of the field of fire, telephone operators, and a plotting board detail should observation permit the plotting of shots. The prescribed program of firing for each gun is shown below. As the results for both guns were practically the same, those for but one are given.

The service velocity for the 2340-lb. projectile is 2700 f. s. and that for the 2100-lb., 2750 f. s. Due to the uncertain direction of ricochets, particularly on rough water, all shots except the third in each series were fired at elevations corresponding to angles of fall that do not ordinarily result in ricochets. This angle was considered as above 14°.

All shots except number four in each series were fired to the eastward along the southern shore of Long Island. Observers stationed near the gun and on the shore about five miles east of Fort Tilden observed the fall of these shots and the safety of the field. The number four shots were fired to the southward where they fell about 7000 yds. off shore in the vicinity of Asbury Park, where observers were similarly stationed.

The office of the Chief of Ordnance in Washington desired to secure pressure curves from all the recoil and counter-recoil cylinders for all rounds, and Mr. Frank Poughkeepsie from Aberdeen Proving Ground, Md., was present with the necessary apparatus and took these pressures. Mr. H. B. Hambleton from the office of the Chief of



One of the New Guns at Fort Tilden at Maximum Elevation

Ordnance, who had actively participated in designing the carriages, was also present throughout the firing.

The maximum pressures recorded in the various cylinders for No. 3 Carriage are given below.

The computed pressure during recoil at 65° is 3225-lbs. and in counter-recoil 4000-lbs. The pressures in the two carriages did not differ materially.

After firing it was necessary to clean the guns again before final star-gauging and coating with oil and cosmoline. The primer vent in the mushroom head was plugged, the block closed, the guns elevated and filled with water for the purpose of softening any residue.

Later, the gun was depressed, permitting the water to run out. An examination of the bore showed quite a deposit of carbon starting with the rifling and extending well down through the bore. The coating was not uniformly distributed but more on one side and following the rifling. It is believed to have been residue from the black powder priming charge. Aberdeen Proving Ground reported that such guns are usually cleaned by using a fire hose and stream of water under good pressure. Only a small stream of water under low pressure was available and this with wire brushes, burlap and mineral wool in the hands of a detachment of about a dozen men finally cleaned the bores of the guns and made them ready for star-gauging and covering with preservatives.

On account of the size of the guns, and the weight of the cleaning implements so far provided, the process of cleaning is difficult. Some means of utilizing the power and movement of the ramming apparatus which operated by a 30-horsepower motor should be devised.

The guns and carriages functioned satisfactorily and, as a result, were considered to have passed a satisfactory test.

Brigadier General Johnson Hagood, with members of his staff from Fort Totten, were present during part of the firing, as were Colonel E. B. Martindale and his assistants from Fort Hancock. Colonel W. B. Ladue, District Engineer, and his assistants were also present. On account of the difficulty of fixing any definite time when the program of firing could be carried out, it was impracticable to have present many who would have been greatly interested.

Colonel Martindale designated Captain A. C. Cleveland, C. A. C., in charge of observers and Safety Officer, and Captain A. M. Jackson, C. A. C., as in charge of Plotting Board detail. Lieut. F. C. McConnell, C. A. C., is in command at Fort Tilden and was in charge of the gun detachment.

Mr. William H. Carpenter is Armament Foreman, 2nd Corps Area, and Mr. G. M. Sauerwein, Jr., Ordnance Resident Machinist at Fort Tilden. All concerned worked hard and faithfully in connection with the mounting and testing of these guns.

Program of Test Firings

Number of Round	Weight of Charge	Weight of Projectile	Expected Pressure		Measured Pressure Lbs., Sq. In.	Elevation of Gun	Recoil of Gun	Expected Range	Observed Range Approximate
			Per Cent Normal	Lbs., Sq. In.					
	lbs.	*lbs.*					*inches*	*yards*	*yards*
1	740	2,340	75	28,500	26,750	12°0′	29	17,000	17,000
2	860	2,340	100	38,000	36,075	11°30′	31½	22,000	22,000
3	900	2,340	110	41,800	41,062	(*b*) 1°48′	31	4,000	(*a*) 4,000
4	915	2,340	115	43,700	42,512	65°0′	37¾	48,000	48,000
5	847	2,100	To give service velocity of		37,527	10°24′	30½	20,000	20,000
6	847	2,100	2,750 f. s.		36,217	10°24′	30¼	20,000	20,000

(*a*) Followed by ricochets.
(*b*) Zero elevation could not be used due to high sand dunes between the guns and shore line.

Maximum Pressures Recorded in Various Cylinders of No. 3 Carriage

No. of Shot	Elevation	Long Cylinder Recoil		Long Cylinder Counter Recoil		Short Cylinder Recoil	
		Upper	Lower	Upper	Lower	Upper	Lower
1	12°0′	2,200	2,146	3,013	2,917	3,269	2,133
2	11°30′	3,116	3,038	3,109	3,039	3,148	2,815
3	1°48′	3,391	3,275	3,870	3,100	3,935	3,052
4	65°0′	3,819	3,693	2,157	2,492	3,693	3,406
5	10°24′	2,963	2,680	3,172	3,039	2,845	2,429
6	10°24′	3,055	2,740	3,109	2,978	3,088	2,607

Pan-American Rifle Matches

THE Secretary of State accepted on behalf of the United States an invitation for this country to be represented at the revival of the Pan-American Rifle Matches. The competitions are being held at Lima, Peru, November 14th to 28th.

The Pan-American Matches were first fired by the United States in 1912, when a team was sent to Argentina and succeeded in bringing back all of the important team and individual prizes. Capt. J. H. Kneubel, Infantry, who is captain of this year's Pan-American team, was a shooting member of the original team which made the trip in 1912.

In 1913, the Pan-American Matches were fired in the United States on the range at Camp Perry, Ohio. The team from Argentina gave splendid account of itself in the United States, winning the Team Match, much to the surprise of everyone.

The World War put an end to further Pan-American competitions until this year, when the occasion of the celebration of the centenary of South American Independence from Spanish dominion, being observed at Lima, offered splendid opportunity for the revival of the competitions, which will now, in all probability, be continued from year to year.

The National Rifle Team Match, 1924

By

G. P. WILHELM

THE National Matches for 1924 which were held during the period August 30th to October 2nd, at Camp Perry, Ohio, were provided for in a law passed by Congress in 1902. The National Matches as originally provided for included the following matches:

a. The National Individual Rifle Match;
b. The National Individual Pistol Match;
c. The National Rifle Team Match;
d. The National Pistol Team Match.

COURTESY: THE NATIONAL RIFLEMAN

The Soldier of Marathon

Since the initiation of the National Matches the entire proposition has grown so that now there is included in them long series of matches under the auspices of the National Rifle Association, which precede the National Match proper. The matches of the National Rifle Association for 1924, which preceded the National Matches, extended from August 30th to September 25th.

The program for the National Rifle Association Matches included various special matches of all kinds. It is the purpose of this article, however, to describe only the 1924 National Rifle Team Match, as this match is the most important of all the matches fired at Camp Perry and is the chief reason why the matches are held.

In the National Rifle Team Match, three magnificant trophies are awarded. For the purpose of these awards, the teams competing are grouped under the head of Service Teams—including the Army, the Navy and the Marine Corps—National Guard Teams and teams representing the civilian marksmen. To the winning team is awarded the National Trophy as provided in the law which, enacted in 1902, created the National Matches. The team with second high score in either of the classes remaining after the National Trophy is awarded, wins the Hilton Trophy. The Hilton Trophy was presented in 1878 by the Hon. Henry Hilton, of New York, to the National Rifle Association as a championship match trophy, originally open to teams from the Army, Navy, Marine Corps, National Guard of the United States and the Regular Army, Militia and Volunteers of foreign countries.

To the high team in the third class after the awards of the National and Hilton trophies, goes the Soldier of Marathon. This is the oldest team trophy in existence, having been presented to the National Rifle Association in 1875 by the Commander-in-Chief on behalf of the State of New York. It was formerly first prize in the Interstate Military Match.

COURTESY: THE NATIONAL RIFLEMAN

The National Trophy

In 1902, when Congress instituted the National Matches, the Hilton Trophy and Soldier of Marathon were presented to the United States Government by the National Rifle Association as prizes in the National Team Match.

After the National Rifle Team Match the first 10 teams are classified as Class A teams, and a distinctive badge is awarded to each member of these teams. The second 10 teams are classified as Class B teams, and a distinctive badge is awarded to each member of these teams. The next 10 teams are classified as Class C teams, and a distinctive badge awarded to each member of these teams.

One trophy is awarded to the highest team representing the United States Services. One trophy is awarded to the highest team from the National Guard or State troops of the several States and Territories, including the District of Columbia. One trophy is awarded to the highest civilian team.

In the past, the most consistent winners of the National Matches for the period 1903 to 1923 have been the U. S. Marine Corps and the U. S. Infantry. The Marines have won the National Match seven times, while the Infantry have won five times. The Infantry, however, have not won a National Rifle Team Match since 1920, while the Marines have won in 1921, 1922 and 1923. Of recent years, on account of the three successive wins by the Marine Corps, the National Team Match has been looked upon as more or less of a Marine victory, and at the best, a contest between the Marines and the Army Service Teams. For this reason in the past few years the interest in the match has been centered around the race between the civilian teams and the contest between National Guard Teams.

The National Rifle Team Match for 1924, however, turned out to be a surprise as neither the Marines nor the Infantry won the match. The contest this year was the most remarkable that has been fired since the Navy Team in 1907 won from the Massachusetts National Guard on the value of the last shot fired in the match.

The National Rifle Team Match has sometimes been referred to as "The

Battle of Giants." The teams which enter the Match are the picked riflemen of the country. For this year's Matches there were eighty-eight competing teams. In addition to the six so-called Service Teams, (there were four from the Army, one from the Marine Corps and one from the Navy) there are forty-eight National Guard Teams. The remaining thirty-four competing teams are classified as Civilian Teams, C. M. T. C. and R. O. T. C. Teams.

The National Rifle Team Match for 1924, started at the end of the 200 yard off-hand shooting with the Marines in the lead with a total of 437 points. The Infantry were second with 433 points and the Engineers third with 427 points. In a contest of the magnitude of the National Team Match the standing of the teams in the early stages of the matches is not indicative of the final standing. It looked, however, as if the Marines and Infantry were again off to their ancient contest.

In the 200 yard rapid fire competition, the first pair of Marines each scored a miss, which to the members of the Infantry team looked very bad for the Marines. However, the second pair of the Infantry team also scored two misses. The Infantry scored 467 points as a result of their rapid firing, while the Marines scored 464 points. This brought the Infantry within one point of the Marines total score.

COURTESY: THE NATIONAL RIFLEMAN

The Hilton Trophy

About this time, however, the spectators who were following the results of the Infantry-Marine contest discovered that there was another competitor in the race, as the Engineers turned in a total record firing score of 485. This put the Engineers far in the lead on the grand total with 11 points.

At the end of the 300 yard rapid firing the Engineers and Marines made exactly the same score, both of them making 469 points, the Infantry making 459. This gave a total score at the end of the third stage of the Match for the Engineers 1381, the Marines 1370 and the Infantry 1359.

At the fourth stage of the Match, which is fired at 600 yards, the Engineers gained another point on the Marines making the total score for the Engineers 1858, Marines 1846 and the Infantry 1840.

The Match was now four-fifths completed; only the 1000 yard firing remained. The Engineers hitherto unknown as a serious contender in the National Matches had a lead of 12 points over the Marines. In the past, however, notably in 1922, the Marines who had been apparently outclassed at the first four stages of the contest had finished so well at 1000 yards that they won the Match. The firing at 1000 yards is the most difficult of all, particularly when the weather conditions are bad. Therefore, while the Engineers had the lead of 12 points over the Marines it was not considered by many that the Engineers had the match won.

In long range rifle shooting the psychological element is the one which often becomes the decisive factor. In order to sustain the morale of the teams, the shooting members of the Engineers and Marines were not allowed to obtain any information regarding the score of the rifle teams.

As the firing proceeded at 1,000 yards it was quite evident, however, that the Engineers were holding the Marines even and that they would easily win the match unless they encountered a strong reversal in form. For the Marines to win they would have to out-shoot the Engineers almost one point per man in the last few pairs, and they were barely holding their own. The Infantry instead of making a spurt to make up what they had lost in the early ranges, were doing worse than ever. So much so that the Coast Artillery Team passed them.

The Marines shooting much more rapidly than the Engineers finished first making a total of 2776 points. One of the veterans of the Marine team made the remark, as the last Marine finished firing, "Well, perhaps the Marines can't win this shooting match but by gosh the Engineers can lose it!" In other words, if the Engineers continued to shoot as they had been doing the Marines could not possibly win the Match, and could only win by the Engineers falling down in the last scores of the last stage. The Engineers, however, had their two best men fire last and both of them finished with a very high score, making the total score for the Engineers 2,782.

The Infantry did not finish third, their score being 2,745 against the Coast Artillery who were third with 2,749.

In connection with the victory of the Engineers in the National Rifle Team Match, it may be remarked that the Engineers did not have a separate team until 1921. They are, therefore, newcomers in the field. Their victory was a very popular one by reason of the fact that they were so to speak, a dark horse, and by their achievement in the National Team Match have shown that the victory is not always won by one of the larger branches of the service. The use of the rifle by the Engineers is of secondary importance and it is all the more to their credit to have been able to beat such teams as the Marines and Infantry have been able to put in the field.

National Rifle Team Match

SCORES

Class "A"

	Slow Fire 200	600	1000	Rapid Fire 200	300	
1. U. S. ENGINEERS (NATIONAL TROPHY)						
Total Score	427	477	924	485	469	
Grand Total						2782
2. U. S. MARINE CORPS						
Total Score	437	476	930	464	469	
Grand Total						2776
3. U. S. COAST ARTILLERY						
Total Score	420	471	919	470	469	
Grand Total						2749
4. U. S. INFANTRY						
Total Score	433	481	905	467	459	
Grand Total						2745
5. U. S. CAVALRY						
Total Score	417	472	907	479	456	
Grand Total						2731
6. U. S. NAVY						
Total Score	425	471	910	454	460	
Grand Total						2730

A Symposium on Optical Glass and Fire Control Instruments

Army Ordnance has recently presented to its readers two articles concerning optical glass and fire control instruments: Major H. K. Rutherford contributed an important paper on "Optical Glass: A Strategic Raw Material," which was published in the July-August, 1924, issue, Vol. IV, No. 25, at page 423; and Dr. I. C. Gardner presented an interesting discussion on "The Standardization of Optical Fire Control Instruments," which appeared in the September-October,1924, issue; Vol. IV, No. 26, at page 512. For the purpose of further interesting our readers in this very important topic several qualified optical glass and fire control experts of the country were invited to comment upon the articles. Their comments are published below

Adequate Stocks and Renewed Interest Needed

By

COL. F. E. WRIGHT

THE phrase "Be Prepared" is the official motto of the Boy Scouts. The same phrase characterizes well the purposes of our Army Ordnance Association, which hinges on the word preparedness, especially industrial preparedness. During the war we had a large overdose of unpreparedness such that we hope for it never again, and are willing, in the abstract at least, to do our best to attain and maintain a state of reasonable preparedness. To that end the articles and discussions in this Journal are valuable because they seek to tell the truth about the many problems in which our Association is interested. If we, as engineers, have the facts before us in times of peace, we can proceed intelligently to appraise a situation and then to take steps so to shape it that when a major emergency does arise we are prepared to meet it. The chief function, then, of ARMY ORDNANCE is to furnish its readers with the unbiased facts that bear on the problems with which the Ordnance Department has to cope. Many of the articles in this Journal are accordingly of the nature of reports on different phases of Ordnance matériel, its design, manufacture, performance under test, etc. Each article covers only a small part of the field and may present only one view of a problem. Further discussion by others interested in the subject is certain to produce a more nearly correct and better balanced picture of the situation. This picture together with other available information constitutes a nucleus on which tentative wartime plans can be prepared and the degree of prepardness of the country in this direction tested.

It is a trite but true saying that the lessons we learned at so much expense during the war are quickly forgotten and neglected, just as has been the Latin and Greek of our school and college days. It seems also to be an Anglo-Saxon trait to avoid much preparation and thought about things which we do not like, such as war; we prefer to "muddle through" when the time comes. Judging by the records of achievement of the Anglo-Saxons we must admit that this method does bring results even in competition with more militaristically inclined races. There is obviously a middle road between too much and too little preparedness and it is the purpose of the Army Ordnance Association and of other organizations of similar nature to counteract the unpreparedness tendency to a certain extent and to maintain proper contact between the several elements which would be called upon in the event of a major emergency.

This point is well illustrated by the optical glass and instrument situation, different phases of which have been ably presented in two recent articles, the first by Major H. K. Rutherford on optical glass and the second by Dr. I. C. Gardner on optical fire control instruments and their standardization. In these papers an excellent estimate of the situation is given and they merit discussion if only to drive home the lessons they teach, lest we forget and fail to grasp their significance. Major Rutherford emphasizes the importance of optical glass as an essential part of fire control instruments and directs special attention to the part now being played by the Optical Shop at Frankford Arsenal in conserving the optical equipment of the Army and also in maintaining a competent personnel to keep abreast of the times in optical matters so that in case of war expert operators can be sent out from Frankford Arsenal to train other skilled instrument makers in the making and assembly of fire control apparatus; also to give expert advice on details in the manufacture of these instruments.

Major Rutherford cites a number of factors which, during the World War, tended to retard the production of fire control instruments. An additional factor, namely that of inadequate realization of the conditions to be met, may be mentioned because it led to serious mistakes which might easily have been avoided. For example, the placing of orders for large numbers of range finders in the early months of the war and the specifying of odd sizes of brass tubing and other parts for certain instruments were sources of much trouble. The result of the range finder orders was that during the first year a large part of the available manufacturing capacity for skilled precision optical work was tied up and could not be utilized for the making of fire control instruments which were urgently needed by our field forces. Had the field conditions under which the Army was to operate been better understood the order for the range finders would not have been placed because they were not needed. It is a matter

of common knowledge among men engaged in field work that the equipment and methods required differ from area to area; if the best results are to be obtained, these differences in field conditions must be taken into account when orders for field equipment are prepared. Thus, if the field operations of an army are to be in a section which is poorly mapped, range finders are of value in aiding the battery commander to ascertain distances; but if the field operations are to take place in a country, such as France, which is well mapped, so that most of the firing can be done from the map, range finders serve little purpose and are not wanted; under these conditions the Army should not be encumbered with a full complement of them. During the last war thousands of short base range finders were produced but were not used. The serious error in judgment which led to the placing of orders for these range finders arose, no doubt, because of rigid adherence to a single plan for the equipment of the Army field forces. A certain flexibility in the plans for equipping the field forces to meet campaign conditions would seem therefore to be appropriate. As a war progresses new developments appear and new apparatus is required for which a certain percentage of the manufacturing capacity might well be reserved.

The optical glass situation in the event of a major emergency need not be serious, but it may be exceedingly so if measures are not taken to insure an adequate supply of desirable types of optical glass, preferably in the form of pressed lens and prism blanks. It is generally recognized that the optical glass industry is a key industry on which much depends and that without optical glass in fire control instruments modern artillery is useless. This is so obvious that further comment would be superfluous. It is therefore surprising that no effort has been made either by Congress or by the Army or the Navy to accumulate an adequate supply of optical glass. Other matters have taken precedence; no orders have been given for optical glass to the makers of optical glass in this country, with the result that operations in these factories have been practically suspended and part of the glass used by the optical instrument makers in this country now comes from abroad. The optical glass industry is not by itself a paying industry unless carried on in connection with the manufacture of other types of glass for which there is a large demand. It would seem, in view of the fact that optical glass, if kept in a dry state, does not deteriorate, a wise plan for the Army and Navy to accumulate against the day of need, an adequate stock of it by placing each year small orders with American makers of optical glass for the few types that are needed.

The plea by Dr. Gardner for a reduction in the number of types of optical systems employed in fire control instruments appeals with special force to the manufacturer. If the few types suggested by Dr. Gardner were adopted and a stock of suitable lens and prism blanks accumulated at Frankford Arsenal for these types, the whole problem of manufacture of optical parts for fire control instruments would take on a different aspect from that which confronted us during the last war.

In this survey of the optical glass and fire control instrument situation by Major Rutherford and Dr. Gardner we find many encouraging elements, especially the fact that the optical shop at Frankford Arsenal is functioning so efficiently not only as the optical repair shop but also as the research laboratory and training school of the Army in optical instrument matters, ready to be called upon at any time. The Navy optical shop at Washington occupies a similar position with respect to the Navy. The Bureau of Standards at Washington has also a corps of scientists and optical engineers available for service; likewise its experimental optical glass plant which should be maintained permanently. The Optical Society of America which includes in its membership most of the optical engineers of the country may also be called on whenever necessary. The other side of the picture is the lack of adequate stocks of optical glass and the present lack of interest in optical glass manufacture in this country. For the next few years this may not be serious; but in a decade or so the present plants which are now practically closed down may be converted to other purposes and no longer available. It would seem wise, therefore, for the Army to place small orders for optical glass each year with American makers of such glass and thus to acquire an adequate stock for use during the early months of a major emergency and to give encouragement to the optical glass industry in this country.

Fred. E. Wright.

Personnel and Standardization

By

LT. COL. G F. JENKS

THE articles on "Optical Glass" by Major H. K. Rutherford and on "Standardization of Optical Fire Control Instruments," by Dr. I. C. Gardner published in recent issues of ARMY ORDNANCE consider important questions affecting the preparedness of the Ordnance Department in the war production of fire control instruments. There are many important details of this problem which will not be considered, but two items stand out conspicuously without the solution of which mass war production of fire control instruments will offer grave difficulties and delays. These are, personnel and standardization.

It is not desired to detract from the importance of the assurance of a supply of optical glass or to minimize the other problems discussed in those articles. But it is desired to emphasize the basic importance of these two items. Indeed they might be combined into one—personnel.

In the formulation of a proper policy of preparedness for the production of fire control instruments, there must be considered the current conditions of the art and the probable trend of development of fire control instruments, as well as the difficulties of war production. It is improbable that the same difficulties will be presented again. Unexpected problems must be anticipated. If they are to

be solved promptly, they must be foreseen. Current conditions must be more carefully analyzed and future conditions forecast.

With minor exceptions, the service is abundantly supplied with optical instruments. Our storehouses are full of them. We have, therefore, no manufacturing programs for the equipment of the army. Our shops are operated at small capacity on repair and experimental work. Current operations cannot give the experience necessary to develop facilities and methods of large scale production.

But the material in the service is that used during the war, based almost entirely on pre-war conceptions of Ordnance. In 1914 our sights for the "75" were graduated up to 6,500 yards. We are now talking about 15,000 yard range for that piece. The maximum range of our seacoast guns was 20,000 yards. We are now installing 16-inch guns with a range of 50,000 yards. It will be seen, therefore, that current developments in Ordnance have presented new problems for fire control which must force revolutionary changes in our fire control systems and require the development of new instruments. The obsolescence of present type instruments will result not only from developments and improvements in optical instruments but largely from the revolutionary changes in the design of artillery matériel. Fire control is an accessory. Its development lags behind that of Ordnance. It may be expected that new instruments will be demanded even at the outbreak of war when every effort must be devoted to production. These demands will not be brushed aside by present day decisions.

The production requirements for new types of fire control instruments will be largely limited by the country's capacity to produce new types of artillery. In the case of marked improvements in such optical instruments as field glasses, range finders and observation instruments, demands for replacement of instruments now in use must be expected. These demands will not at present enter into our requirement schedules.

Under current conditions, the Ordnance Department can not maintain a balanced personnel or operate balanced facilities. The current problem is research, development and design. This permits the development of laboratory and design engineering personnel and equipment. It offers no means of development of production personnel nor the modernizing of facilities and methods. The tendency is to become more and more out of date. The stoppage of production reacts on development and design. Without competitive production, standardization degenerates into impractical design requirements and specifications into descriptions of obsolete shop methods or prescriptions for impractical scientific tests.

Current laws and regulations do not seem to permit the development of specialists among the commissioned officers, either for development or production of fire control instruments. The present staff has been placed on these duties within two years. Unfortunately the civilian staff has not been developed to such an extent that specialists among the commissioned grades can be dispensed with. Current appropriations are not sufficient for such development.

In the commercial world progress proceeds at a comparatively even rate. Competition requires specialists and, in turn, develops them. Specialists develop new methods, new facilities and new products. The service personnel and facilities are not reacted upon by competition. As the war recedes into the more remote past, they lag more and more. Adoption of past war practice and solution of current problems by the past war formulae will not keep the service abreast of the times.

The facilities required to manufacture fire control instruments are not complex or expensive. They exist largely as standard. The instruments themselves are comparatively simple to manufacture and can be made in comparatively short time if the design is perfected and the methods of manufacture are developed, and if skilled personnel is available.

The problem resolves itself almost entirely into one of personnel—personnel to develop and perfect the design, personnel to make the design producible with the least effort, using commercial practice and facilities, and personnel to organize production and to produce.

The solution of the personnel question does not rest in contracting for all development and production work with commercial concerns. Under current conditions they cannot afford to do it. There is no guarantee of profit from production. For other reasons which cannot be discussed here, the government must solve these problems or remain unprepared for war production of fire control instruments.

If the Ordnance Department is to develop commissioned personnel capable of solving these problems—and no quantity of war plans locked up in a safe will avail one bit if experienced, qualified personnel are lacking to initiate and execute them—then officers must be assigned to these problems and must be allowed to become specialists in their line if they are capable of and inclined to become such. They should be informed that they will be allowed to remain on such work and should be made to understand that their future assignment depends upon their accomplishment. They should be expected and required to associate themselves professionally with those in the industrial world engaged in similar work and given every opportunity to keep up to date. This includes a policy of assignment of commissioned officers on the research engineering and production staffs of the up-to-date commercial manufacturers, as well as assignment to universities for preliminary education. Of course, such a policy requires the assignment of a greater number of officers to fire control work. But if the number assigned to this work is not increased, there can be no hope of being prepared for war production unless a civilian staff is built up following a similar policy for their development.

The importance of standardization cannot be over emphasized. Instrument manufacturers are sadly unprogressive and far behind good commercial practice in standardization of product. Not only are there practically no standards common to different instrument makers but manufacturers have but crude standards for their own use. Consider the saving in time for initial war production and in cost if fire control instruments could be made with the standard small tool equipment of the commercial plant and if government specifications permitted the following of commercial methods and practice!

These ideal conditions can be largely realized if the instrument manufacturers are willing to assist. Standardization of fire control instruments by adoption of government or arsenal standards would be of great value in reducing the effort of war production. Such a policy would

not, however, permit of utilization of the tool equipment of commercial plants. But the standardization of parts and details of fire control instruments to conform to standards and standard practice used commercially would be of far greater saving. National standardization is necessary if war production is to be accomplished with the least effort in the minimum time.

A practical method of handling this work would be the formation of a standardization committee composed of representatives of interested commercial concerns and of the interested government departments. Such a committee could be organized by a National Optical Society or by the American Engineering Standards Committee. No attempt should be made by government departments to dominate such a committee or its work. The policy of the government should be to assist commercial concerns to find standards which could be used both commercially and by the government.

War requirements can not be computed with any degree of accuracy. Requirements vary with the special conditions thrust upon the country at the time war is declared. The requirements and priority of material will vary widely with the character of the enemy, the theater of operations and with other factors. The preparation of plans is excellent for training. It is highly essential but the performance of the Ordnance Department in the war production of fire control instruments will depend upon the number and expertness of its personnel and their intimate knowledge of the industry—not upon requirement schedules and paper orders.

The greatest service that the industry can render the Department for war preparedness in the manufacture of fire control instruments is to asist in the training and development of its personnel and in the development of standards of design, inspection and production. The greatest step that the Ordnance Department can take to secure war preparedness in the production of fire control instruments is to accept such assistance and establish a policy of utilizing it.

Standards in Fire Control Instruments

By

DR. HERMANN KELLNER

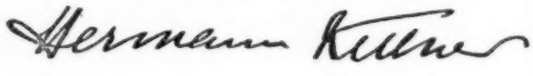
IT seems difficult to add much to a discussion on optical glass and fire control instruments. The subject has been freely discussed and any addition seems to be necessarily a repetition. If in complying with the editor's request I do not say anything substantially new about standardization of optical parts, I have to ask your indulgence.

The reason for the very inhomogeneous character of the fire control instruments used in the War by the Army may lie in the fact that the latter did not seem to have as definite a program for the development of optical war material as the Navy. Consequently there was a sudden demand for copies of foreign instruments which, for uniformity's sake and lack of time, had to be copied with faults and in shapes that looked very obnoxious to eyes accustomed to American design. These complications, which in a good many cases bordered on confusion, could have been avoided if someone had at least partly anticipated the problem, as the Navy had done for years.

The Bausch and Lomb Optical Company has been cooperating with the Navy since the beginning of the century in the development of a series of fire control instruments adapted to meet their special requirements. One of our first problems was the design of the well known Mark XI gunsight (1905) which consists of an objective, erecting system, eyepiece, and two collectives. Each of these components is independently usable and especially the objective and eyepiece have been employed in several other telescopes. They have always been standards with us and have been copied by other firms at the Government's request. The eyepiece has found its way into Dr. Gardner's collection of standards. We do not confine this practice to gunsights only but carry it through wherever possible. Of course, all standards of such a nature can only remain standards so long as nothing better is found and the design of a wide field eyepiece, for instance, may suddenly make obsolete established standards just at the time when need for production is greatest.

In the watching and anticipation of such possible progress lies a great responsibility for our Naval and Army optical research men, particularly, when we consider the difficulty, or almost impossibility, for one person or small group of persons to steer all the development without at times overlooking important openings. It is here where the competition between several firms in cooperation with the Navy department brought such beautiful results in Germany. This intense development work can, of course, only be expected when there are financial compensations in view of sufficient magnitude to warrant the maintenance of a force of skilled engineers and workmen.

The term "standard" should not be interpreted to mean an unchangeable and unsurpassable achievement. Sometimes, by digressing from standard dimensions certain advantages may be gained and the representatives of the Navy have never hesitated to waive standardization ideas for any slight gain in quality and it may be easily seen how an instrument made up of standard units may not represent the highest standard of optical performance.

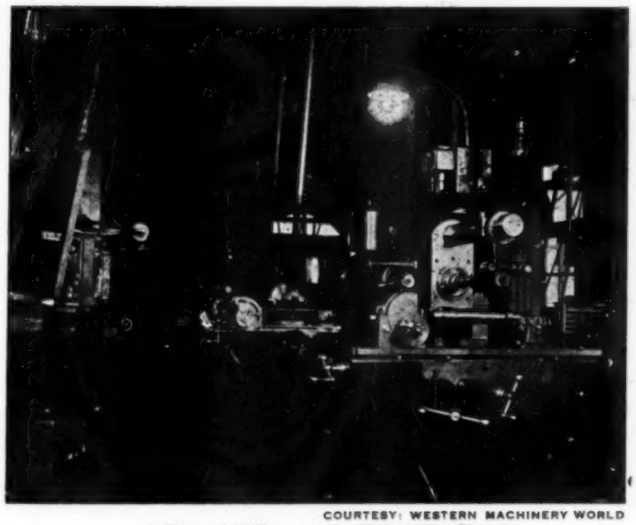


Army Ordnance at the University of California*

By

ARTHUR B. DOMONOSKE

DUE to the steady growth of manufacturing facilities on the Pacific Coast, the San Francisco District Ordnance Office was established about a year ago as a part of the well known plan of "Industrial Mobilization" authorized by the National Defense Act of 1920. It was realized that the successful functioning of such an office in the time of war would be possible only with a corps of previously trained reserve officers. A few such officers with experience in the World War were available and were with their approval assigned to definite places on the organization chart of the District Office.



COURTESY: WESTERN MACHINERY WORLD

A Row of Millers at the University Shops

However, there were not nearly enough, and those who had offered their services appreciated that no time should be lost in training young men to step into their places. So here we have at our own doors a striking example of the need for young officers, recruited from the generation that has had no war service. It is to fill these vacancies in the San Francisco Ordnance District, and simular vacancies throughout the units of the organized reserves, that Reserve Officers Training Corps has been established.

At the University of California the Ordnance Unit of the training corps has been actually in operation but four months, but there seems to be no question as to its future success. Selected young men in the third and fourth years of the mechanical engineering and chemical courses are trained in the more fundamental technical duties of an Ordnance officer. To a very large extent these young men are trained by the regular professors of the university in connection with their prescribed curicula, since the fundamentals of Ordnance are those of chemistry and mechanics. To correlate such work and show its application to the Ordnance field, a special course is given by an Ordnance officer detailed from the Ordnance Department of the Regular Army. The officer at present on this duty, Major R. W. Pinger, a graduate of the University of California from the College of Mechanics, is well fitted to handle such a problem, because of his knowledge of both conditions existing at the university and the requirements of the Ordnance Department.

COURTESY: WESTERN MACHINERY WORLD

A Former Ordnance Department Automatic at University of California

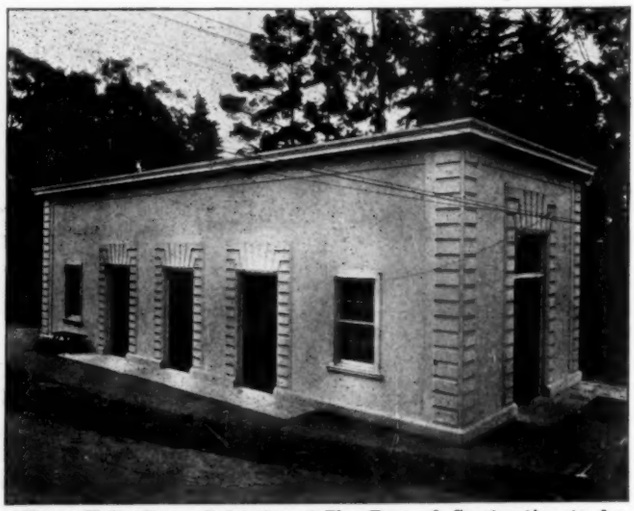
The Ordnance course as now given parallels the work of the other Officers' Reserve Training Corps Units in many respects, but differs in one very important detail. To enter the Ordnance Unit, a student must have completed one of the basic military courses, but thereafter drill is discontinued, and all his available time devoted to the study of Ordnance, its use, problems of design and of production.

In the first (junior) year a weekly lecture is given covering the entire field of Ordnance from a general standpoint. Starting with the more elementary forms of ammunition, the student learns of projectiles, explosives, propellants, guns, carriages, fire control equipment, small arms, automatic arms, tanks and tractors. Throughout this course, mathematics is minimized and physical concepts emphasized. Thus the student learns the general relationships existing between the things we know as Ordnance before he attempts, as a senior, the detailed problems of design and production. A university credit of one unit per semester is given for this course.

The present status of Ordnance precludes the use of a single text book; therefore the student prepares for lecture by reading widely from a growing

*Reprinted from *Western Machinery World*, July, 1924.

Ordnance library which is made available to him. He is encouraged to pursue in considerable detail collateral subjects which appeal to him, since it is not expected that the chemistry student will be interested in the same problems as the mechanics student. To derive the greatest benefit from such reading, a weekly conference is held, at which the students present their subjects to the class. This is valuable training to the student lecturer himself and at the same time makes the meat of the reading available to the others. Thus the course as a whole covers a larger field than would be possible by assigning the same reading to each student. No university credit is given for this conference, but the students readily concede it to be one of the most interesting elements of the course.



Hesse Hall—Steam Laboratory. The Type of Construction to be Used in Future Shops

The third element in the course consists of an afternoon (three hours) of practical drafting and laboratory work, for which one university unit is given. Here the students sectionize ammunition, draw flow sheets of various explosives, make schematic representations of various types of recoil mechanism, and construct display boards. Later chemical analyses of materials and metallographic work will be attempted. The students, of course, solve such problems in their own laboratories. In general the practical work parallels the lecture course and offers an excellent opportunity for the student to ask questions and work out for himself problems for which time is not available in the lecture course.

Valuable as this practical work is, it frequently conflicts from a time standpoint with the regular engineering and chemistry laboratory periods. As the Engineering and Chemistry Colleges give full credit to the Ordnance courses, the Ordnance Unit, therefore, returns the compliment by offering ordnance credit for such academic courses as are of special value to the Ordnance Department, as those in automotive design, metallurgy, physical chemistry and many others. In other words, to complete the five hours devoted to military training for which the Government rewards the student with a "ration" (value about $9.00 per month), as much credit is given for three hours devoted to metallurgy as for three hours drill in the infantry unit.

Between the junior and senior years comes camp. This year the men will go to Fort Casey, Washington, for about five weeks, and to Camp Lewis for about one week. Such training as is common to all arms, such as infantry drill, physical training, small arms practice, and the like, will be taken in conjunction with the Coast Artillery Units. The important feature of the camp, however, will be the practical training in the use of ordnance, with which a Coast Artillery fort is probably more liberally supplied than any other activity in the Army. The men will shoot everything which can be fired, not merely with the idea of hitting a target, but from the scientific, proving ground viewpoint. Every possible ballistic variable will be introduced, and every possible effect measured. Every shot will be an engineering experiment, the data for which will be used for some of the laboratory work of the senior year.

Gradually other Ordnance Units will be organized in the West (California has the only one west of Wisconsin), and to the work itself will be added the stimulus of contact with other college men of similar interests, a most valuable feature of camp life.

During the senior year the entire ground is covered a second time, but from quite a different point of view. Certain subjects will be very lightly touched, but others will be investigated from a detailed standpoint of design and manufacture. By this time many of the fundamental academic courses of mechanics and chemistry will have been covered, so that the men will be much better equipped than in their junior year. During the last semester of the course the relationship of the whole problem to that of industrial mobilization of the nation in time of emergency will again be emphasized and an attempt made to bring to each student's mind a visualization of his actual duties should war ever come. Finally, upon graduation, he will be given his commission as Second Lieutenant, Ordnance Officers' Reserve Corps. If he treats this document as a symbol of his ability to serve his country intelligently, rather than as a mere reward for study, the object of the Ordnance course at the University of California will have been accomplished.

Chemists to Discuss Corrosion

AT the Baltimore meeting of the American Chemical Society which will be held during Easter week, the Division of Industrial and Engineering Chemistry will hold a symposium on Corrosion. At the present time the tentative outline of the symposium is as follows:

1. Submerged Corrosion of Metals—
   a. Iron and Steel;
   b. Non-ferrous Metals.
2. Atmospheric Corrosion.
3. Corrosion of Special Alloys.

It is hoped that the scope of the papers of this symposium will cover the problems of corrosion in the heavy chemical industry, in the special chemical industry, in the marine world, in ordnance equipment, in the oil industry, mining industry, etc. Papers relating to any of these subjects or subdivisions will be welcomed by the chairman of the symposium, who is Robert J. McKay.

In case one plans to present a paper before this symposium he should correspond at once with Mr. McKay or the secretary of the Division.

The Influence of Temperature on the Explosibility of Ammonium Nitrate*

By

G. W. JONES

THE work herein reported represents the fourth phase of the general investigation on the explosibility of ammonium nitrate, conducted by the Explosive Section of the Bureau of Mines, under direction of the National Research Committee on the investigation of the explosibility of ammonium compounds. So far, the four papers[1] listed below have been published.

A knowledge of the influence of temperature on the sensitivity of ammonium nitrate is important in connection with its manufacture and utilitization. During preparation of ammounium nitrate, heat is applied; and when it is used or blended with other materials, such as in the manufacture of the military explosive amatol, it is heated.

Historical

Previous investigators[2] have determined the effect of temperature on the explosive properties of ammonium nitrate at relatively high temperatures (above 200° C.). Saunders[3] in particular has shown that,

Pure ammonium nitrate decmoposes into nitrous oxide (N_2O) and water (H_2O) to the extent of 98 per cent, the course of the decomposition remaining unaltered over a temperature range from 210° to 260° C. At some point near 300° C. other nitrogen oxides are evolved, and the action proceeds explosively. Up to 260° C. nitrogen is present in the decomposition products to the extent of 2 per cent, and immediately after explosion the percentage increases to 40 per cent.

These results indicate that ammonium nitrate, on changing from decomposition to detonation, shifts from reaction

(1), $NH_4NO_3 \rightarrow N_2O + 2H_2O$,

the decomposition reaction, to reactions

(2), $2NH_4NO_3 \rightarrow N_2 + 4H_2O + 2NO$, and
(3), $2NH_4NO_3 \rightarrow 2N_2 + 4H_2O + O_2$,

the explosion reactions.

The proportions of nitrogen given by Saunders indicate that both reactions (2) and (3) take place simultaneously, the extent to which either predominates probably depending upon the temperature at which the explosion takes place, the purity of the ammonium nitrate, confinement, and density, and perhaps other variables.

Little information is available regarding the sensitivity of ammonium nitrate at temperature below 200° C., and since it is these lower temperatures that ammonium nitrate is subjected to during manufacture, distribution, and use, this investigation, by recommendation of the Committee, has covered a temperature range of 10° to 140° C.

In this temperature range ammonium nitrate exists in several crystal forms. Millican, Joseph and Lowry[4] give the following transition points for pure ammonium nitrate:

Crystal Form—	Transition Point, °C.
Tetragonal	to —16
Orthorhombic	—16 to 32.1
Rhombohedral	32.1 to 84.1
Tetragonal	84.1 to 125.2
Cubic	Above 125.2

The temperatures at which the tests were made—namely 10, 40, 80, 120, and 140 °C.—were chosen so as to cover most of these crystal forms.

After reviewing the tests made by Sherrick,[5] it was decided to employ the condition that would be most likely to bring out prominently the effect of temperature—that is, the condition of least confinement and smallest feasible booster. In view of the above consideration, Shelby seamless tubing was selected with walls 1/16-inch thick. Twenty-five grams of booster were used for each test, and a series of tests made with five different boosters, and all tests made at the normal shaking density—approximately 0.71.

Material Used in Tests

Ammonium nitrate: This was from the same supply used by Sherrick in the tests previously reported. It was designated a "B. A. S. F. 550" ammonium nitrate and was given for the tests by the Hercules Powder Co. It was dried and stored in "EZ" seal glass jars. It had already been dried to a moisture content of 0.1 per cent. Analysis of the salt made just prior to these tests is as follows:

Constituent	Per cent
Moisture	0.38
NH_4Cl	.03
Fe_2O_3	.09
Insoluble	.04
NH_4NO_3	99.46
Sulphates, thicyanates, nitrites, nitrides, oils	none

*Report V of the Committee on the Investigation of the Explosibility of Ammonium Compounds, National Research Council, conducted in cooperation with the Bureau of Mines. Published by permission of the Director, Bureau of Mines.

1The explosibility of ammonium nitrate, by Charles E. Munroe, *Chem. and Met. Eng.*, vol. 26, 1922, pp. 535-542.
Fire risks with ammonium nitrate, by J. L. Sherrick, ARMY ORDNANCE, vol. 4, 1924, pp. 237-241.
The influence of confinemcnt upon explosibility of ammonium nitrate, by J. L. Sherrick, ARMY ORDNANCE, vol. 4, 1924, pp. 329-333.
The influence of density of packing upon explosibility of ammonium nitrate, by J. L. Sherrick, ARMY ORDNANCE, vol. 4, 1924, pp. 395-400.

2The decomposition of ammonium nitrate by heat, by H. L. Saunders. *Jour. Chem. Soc.*, vol. 121, 1922, pp. 698-711.
The explosive properties of mixtures containing ammonium nitrate, by A. J. Der Weduwen. *Chem. Weekblad*, vol. 19, 1922, pp. 541-542.
The decomposition and stability of ammonium nitrate in the presence of oxidizable material, by A. Findlay and C. Rosebourne. *Jour. Soc. Chem. Ind.*, vol. 41, 1922, p. 58.

3Saunders, H. L., work cited.

4The properties of ammonium nitrate, by I. L. Millican, A. F. Joseph, and T. M. Lowry. *Jour. Chem. Soc.*, vol. 121, 1922, p. 959.

5Sherrick, J. L., work cited.

Screen tests on the dried ammonium nitrate gave the following results:

Mesh	Per cent by weight.
On 10	1.7
On 10 to 20	57.7
On 20 to 35	37.0
On 35 to 48	2.8
Through 48	.8

Boosters: The following boosters were used in the tests: Tetryl, picric acid, TNT, 80/20 amatol, and a 75/10 ammonium nitrate-nitroglycerin dynamite. The analyses of the first three mentioned are as follows:

	Tetryl	Picric acid	TNT
Melting point, °C.	128.9	------	----
Solidification point, °C.	-----	121.06	80.2
Moisture, per cent	0.03	0.64	----
Insoluble matter, per cent	0.24	0.031	----
Acidity, per cent	0.00	------	----
Ash, per cent	0.08	0.018	----
Nitrogen content, per cent	-----	18.17	18.14
Shaking density	0.99	0.93	0.96

80/20 amatol: This was from a lot which had been melted and cast without stirring. There was considerable variation in different portions of the cast, as shown by the following figures taken from eight analyses:

Constituent	Variation per cent.	Average per cent.
Moisture	0.04 to 0.06	0.05
Ammonium nitrate	71.30 to 83.19	79.95
TNT	16.76 to 28.64	20.00

As the cast was broken up and thoroughly mixed, the average values represent fairly accurately the composition of the material used. Its shaking density was 1.00, and apparent specific gravity 1.08.

75/10 ammonium nitrate-nitroglycerin dynamite: This booster analyzed as follows:

Constituent	Per cent.
Moisture	0.35
Nitroglycerin and nitropolyglycerin	10.32
Ammonium nitrate	74.03
Sodium nitrate	1.99
Calcium carbonate	.51
Carbonaceous combustible material	5.93
Sodium chloride	6.87
Total	100.00

Electric detonators: No. 8 electric detonators were used. These contained approximately a 2-gram charge of a mixture of 80 per cent mercury fulminate and 20 per cent potassium chlorate.

Test Procedure

Shelby seamless tubing was received from the manufacturer in about 8-foot lengths. These were then cut into 8-inch lengths. Due to the slight variation in thickness in different portions of the tube, those tubes were discarded where the variation was 3/124-inch or more. The selected tubes were thoroughly cleaned of oil and metal fillings, smoothed off evenly at one end, and closed at this end with a 0.25 by 1½-inch steel disc. This disc was forced into the tube flush with the end as shown in Fig. 1.

One hundred grams of the ammonium nitrate was then poured into the tube and shaken down by raising the tube and dropping it a distance of 2 inches on a large lead plate covered with a 2-inch oak block, until on repeated measurements the surface level of the ammonium nitrate failed to lower in the tube after dropping 20 times on the block. The density was then calculated from the length of the charge in the tube, the diameter of the tube, and the weight of ammonium nitrate added. One thickness of white glazed wrapping paper, slightly larger than the diameter of the tube, was then inserted into the tube on top of the ammonium nitrate and gently pressed tight to keep the ammonium nitrate from spilling during the heating and testing. The tubes were heated in an electric oven at the desired temperature for at least 18 hours before shooting. Those which were tested at the ordinary temperature without heating were closed with tight-fitting rubber stoppers until immediately before shooting. The reason for this was to prevent the ammonium nitrate from taking up moisture.

Details of a tube assembled on a lead block and ready to be shot is shown in Fig. 1. The booster charges of 25 grams were carefully weighed, poured into a short paper cartridge 1⅜ inches in diameter, and tamped lightly. The paper containers were made from a piece of unglazed paper 3 inches wide and 4 inches long. Each paper container weighed approximately 1 gram. The boosters which contained ammonium nitrate were stored in a dessicator until ready for use, to prevent absorption of moisture; while those containing nitroglycerin were prepared just prior to use, because the paper absorbed some of the nitroglycerin from the charge.

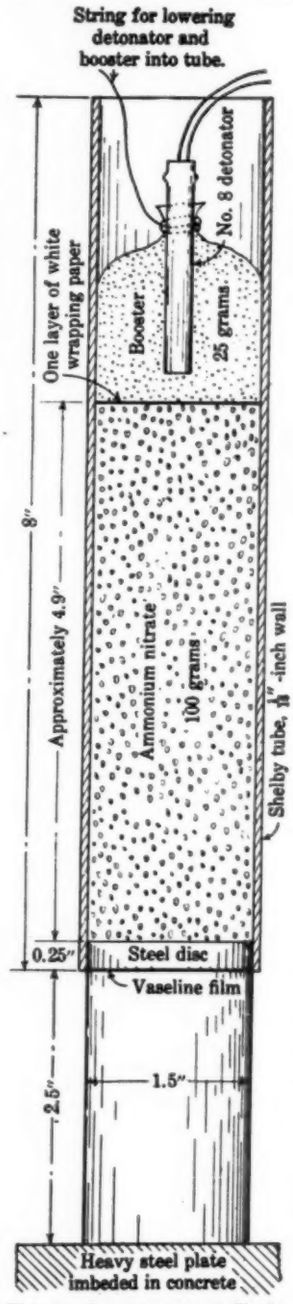


Fig. 1. Arrangement of Explosive, Shelby Tubing and Lead B'ock for Tests on Explosibility of Ammonium Nitrate

In the tests made at the ordinary temperature the following procedure was followed: The lead block was carefully measured to the nearest 0.25 millimeter, then coated at one end with a thin film of vaseline, and set on the steel base plate with the vaseline coated end on top. The metal tube containing the ammonium nitrate was then placed on the lead block, as shown in Fig. 1. A No. 8 detonator was inserted in the booster charge, and the top of the paper container for the booster was crimped around the detonator and tied with a string. The booster and detonator were then inserted in the tube and pressed down on the charge of ammonium nitrate with a small tamping stick. The charge was fired electrically.

For the tests at elevated temperatures, the procedure

was modified as follows: The booster and detonator and lead block were assembled in the bomb proof, prior to mounting the tubes containing the ammonium nitrate. The assembled booster and detonator were suspended ready for insertion over the steel base plate. Strips of asbestos were heated in the oven along with the tubes containing the ammonium nitrate, and when the tubes had been heated sufficiently, one was removed, wrapped in the heated strips of asbestos, and immediately taken to the bomb proof, mounted on the lead block, the detonator and booster inserted, pressed down gently on the charge of ammonium nitrate, and fired. Not more than one minute was consumed from the time the tubes were removed from the oven until they were fired. The results of the tests are shown in Table 1.

Before making any tests at temperatures above atmospheric, as a precaution against possible accident from dropping, some of the ammonium nitrate was heated to 140° C., the maximum temperature in this investigation, and was tested in the large impact machine[6] at that temperature to see if it could be detonated by impact. It was impossible to detonate the ammonium nitrate at this temperature by this method, even when the 200-kilogram weight was dropped from the maximum distance of the apparatus—namely, 7.5 meters.

The above results are shown graphically in Figure 7.

Discussion of Results

Inspection of Table 1 shows that by heating the ammonium nitrate from 10° to 140° C., compression of the lead blocks was increased approximately threefold, irrespective of the booster used. In other words, the sensitivity to detonation of ammonium nitrate is much greater at the elevated temperature.

Inspection of Figures 2, 3, 4, 5 and 6, photographs of the lead blocks after shooting ammonium nitrate with the different boosters, throws considerable light on the question as to the extent of the detonation of ammonium nitrate at the lower temperatures. In each of the figures, as the temperature is increased, in general the compression increases, and appears to have reached a maximum at 140° C. It also will be noted that for each booster, above a certain temperature the curvature on the top of

[6]For description of large impact machine see Tests of permissable explosives, by Clarence Hall and S. P. Howell, Bureau of Mines Bull. 66, 1913, p. 17.

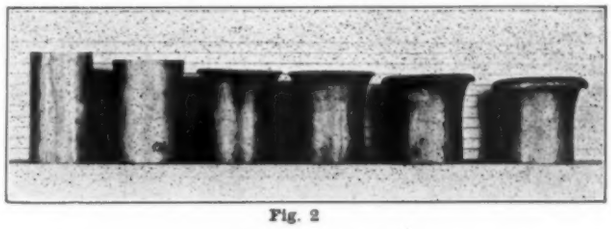


Fig. 2

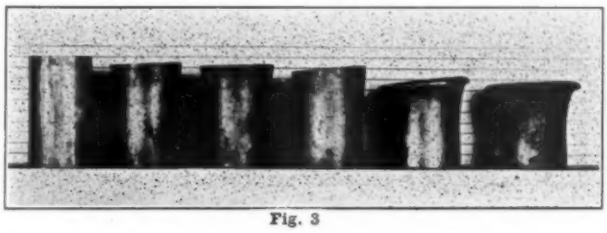


Fig. 3

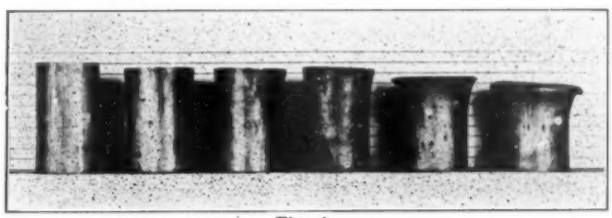


Fig. 4

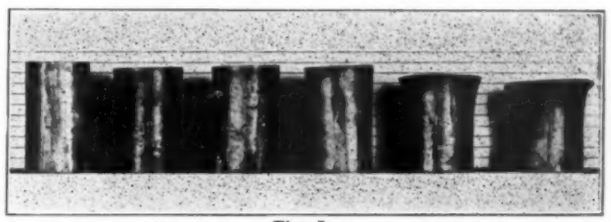


Fig. 5

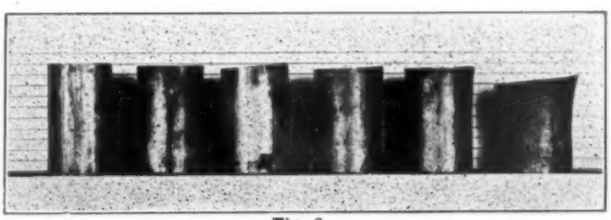


Fig. 6

Table 1

Compression of lead blocks when 100 grams of dried ammonium nitrate was shot in Shelby seamless tubes having walls 1/16-inch thick, at varying temperatures.

Booster	Tetryl		Picric Acid		TNT		80/20 Amatol		75/10 Ammonium Nitratenitroglycerin Dynamite	
Temperature	Density of charge	Compression of lead block	Density of charge	Compression of lead block	Density of charge	Compression of lead block	Density of charge	Compression of lead block	Density of charge	Compression of lead block
°C.		mm.		mm.		mm.		mm.		mm.
10	0.70	4.75	0.73	4.25	0.69	3.50	0.70	2.75	0.70	1.75
40	0.68	9.50	0.76	5.50	0.74	4.50	0.72	3.25	0.72	2.50
80	0.68	11.50	0.69	7.75	0.69	5.50	0.71	3.00	0.71	3.75
120	0.74	12.00	0.70	12.75	0.68	9.25	0.70	9.25	0.70	3.00
140	0.71	14.00	0.74	13.25	0.66	12.25	0.74	10.50	0.71	10.25

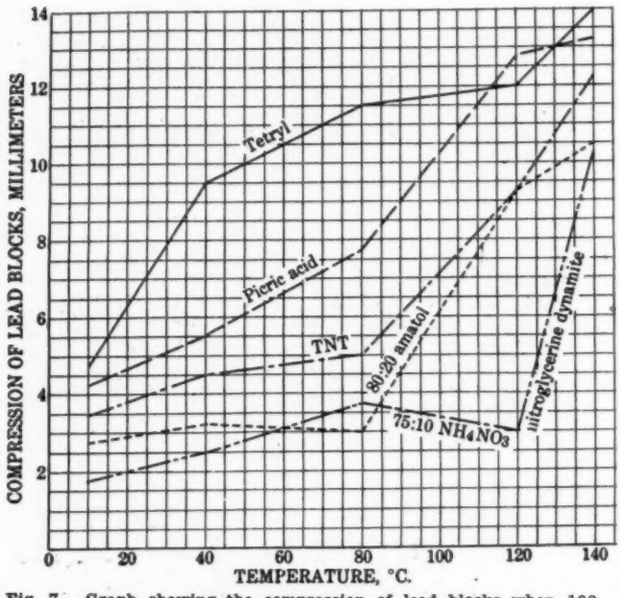


Fig. 7. Graph showing the compression of lead blocks when 100-gram charges of ammonium nitrate were shot in Shelby seamless tubes having walls 1/16-inch thick at varying temperatures. 25 grams of booster were used in each test and fired with No. 8 detonators. Density of ammonium nitrate approximately 0.71

the lead blocks changes from concave to convex. If detonation is only partial, the steel disc merely makes an indentation in the top of the lead block without flaring off the top similarly to that of a mushroom. The temperature at which the top of the blocks changes from concave to convex varies with the booster used. Compression of the lead blocks with no detonation of the ammonium nitrate will vary, due to the effect of the different boosters on the block. Tests made by the Bureau of Mines with the different boosters unconfined, when 50 grams of each was wrapped in paper and placed directly on top of the block, gave the following results:

Booster	Compression of lead block mm.
Tetryl	22.4
Picric acid	18.7
TNT	16.2
80/20 amatol	10.5
75/10 NH_4NO_3-glycerin dynamite	7.9

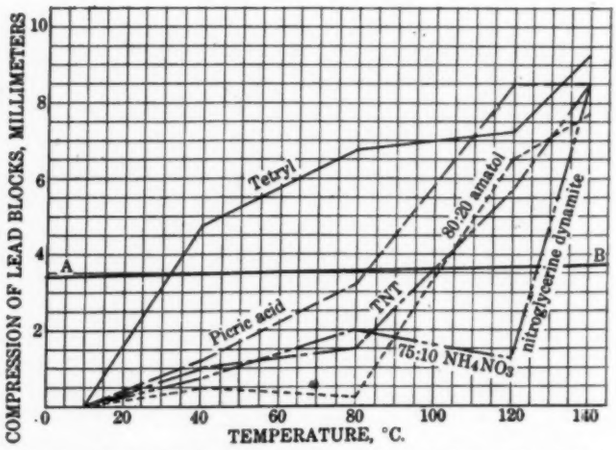


Fig. 8. Graph showing compressions corrected for effect due to boosters

Since the conditions under which the above tests were made are different from the steel tube tests, the results can be used only as a comparative basis. The order of compression, however, is the same as those given in Table 1 for tests made at 10° C. These results were as follows:

Booster	Compression of lead block mm.
Tetryl	4.75
Picric acid	4.25
TNT	3.50
80/20 amatol	2.75
75/10 NH_4NO_3-nitroglycerin dynamite	1.75

Effect of Boosters

Observations made during these and previous tests by Sherrick[7] warrant the conclusion that in the tests at 10° C. the compression of the lead blocks is wholly due to the boosters. To show more clearly the relative sensitivity to detonation of ammonium at different temperatures to the different boosters, the curves of Figure 7 have been redrawn as in Figure 8, with compressions produced by the boosters at 10° C., subtracted from the compressions at higher temperatures, eliminating the effect of boosters. Attention is called to the fact that at 140° C. the compression of the lead blocks due to the ammonium nitrate is practically the same (within experimental error of the method), irrespective of the boosters used. In other words, at 140° C., ammonium nitrate is equally sensitive to detonation by any of the boosters used.

At the next lower temperature, 120° C., tetryl, picric acid, TNT, and 80/20 amatol gave complete detonation; while the 75/10 ammonium nitrate-nitroglycerin dynamite gave only partial detonation, and only slightly more than that at odinary temperatures.

At 80° C., only tetryl gave complete detonation, while all of the others gave incomplete detonation, varying over a considerable range. The order of efficiency for promoting detonation at this temperature is as follows: tetryl, picric acid, 75/10 NH_4NO_3-nitroglycerin dynamite, TNT, 80/20 amatol.

At 40° C., the efficiency of the booster stands in about the same relation as that for 80° C. Some shifting in the positions of the less efficient boosters is seen at 40° as compared to 80°, but the changes are so slight as to be within the experimental error of the method used.

The curves in Figure 8 bring up an interesting question, which is—if detonation is complete, as shown by the shape of the lead block at a given temperature—why is it that further increase in temperature gives increased compression of the lead blocks? This can be explained as follows:

The lead block test, as used in the testing of explosives, measures the quickness of an explosive—that is, the rate of detonation. In general, compression of the lead block by equal weights of explosive, is proportional to the rate of detonation of the explosives.

In the case of ammonium nitrate, as the tests shown in Figure 8, compression increases as the temperature is raised, which may be explained, in view of the above discussion, as due to the fact that although detonation may be complete at a lower temperature, the increase of

[7] Sherrick, J. L., work cited.

(*Continued on page 626*)

America's Oldest Munitions Plant

THE recent effort on the part of the citizens of Baltimore to preserve the old shot tower which stands not far from the center of the city has brought to light some interesting history concerning this and other similar towers which years ago dotted the Atlantic Coast. Several weeks ago *The Baltimore Sun* published the following interesting data concerning these early munition factories:

Phoenix Shot Tower, of Baltimore, whose fate is uncertain, was one of those shot towers built as the outcome of commercial difficulties between the United States and Great Britain prior to the War of 1812 and consequent high duty upon imported shot.

There were a few towers on the Atlantic Coast in the early nineteenth century and a few in Mississippi. The Phoenix while not the first to be erected, seems to have been the highest of those of which record has been found.

Unfamiliar Data Found

Miss Harriet P. Marine, State chairman for Maryland of the national committee on preservation of historical spots and of the national committee on preservation of records, both of the Daughters of the American Revolution, has found much hitherto unfamiliar data of the Baltimore and other Atlantic Coast shot towers in researches during the last few weeks relative to the Baltimore tower, an appeal for help in whose preservation is to be made to national patriotic organizations.

Phoenix Tower, known also as the Merchant's Shot Tower, is the only shaft of its kind standing virtually intact in the United States, and, so far as Miss Marine has been able to ascertain, in the world.

New York Towers

New York City had Colwell's Shot Tower on Center street and another shot tower on Cliff street, and an old picture shows a shot tower that once stood near the East river.

Thomas Otis Le Roy & Co.'s shot and lead works was among the most interesting manufacturing establishments of New York City. Its shot tower was situated on part of a block extending from Fifty-third to Fifty-fourth streets on the East river, having a water front of 250 feet, with 40-foot depth of water, navigable for the largest craft and affording splendid shipping facilities.

The tower was octagonal in shape, 150 feet high, 23 feet in diameter at the base and 12 feet at the top. The walls were four feet in thickness at the lower floor. The view from the top was extended, overlooking Blackwells Island and extending to Astoria, Ravenswood, Hunters Point, Green Point and Brooklyn.

The Phoenix Shot Tower
Baltimore

These works were established by Thomas Otis Le Roy in 1845 and included many departments of this manufacture which combined so much of science and practical skill. The works included two factories in different parts of New York and a separate salesroom at 54 East Thirteenth street. The firm had an extensive plant on Water street, where was manufactured a celebrated Eagle brand shot made by a then new process.

The usual method of manufacturing shot was by dropping the lead from the top of a lofty tower. In its descent, however, the lead was in danger of becoming flattened from one cause or another, and in Le Roy's factory counter-currents of cold air were blown upon the falling metal, buoying it, retarding momentum, etc., thus preserving spherical shape so that it was not necessary to drop it from quite so great a height and the effect of oscillations of the buildings were also overcome.

Towers in Philadelphia

For Philadelphia, a local paper, the *Aurora*, of November 15, 1808, in a list of manufacturing plants, speaks of three shot towers—that of Paul Beck, that of Bishop & Sparks, and that of R. Hovenden.

On February 13, 1815, news of the treaty of peace between the United States and Great Britain, which was signed at Ghent, Christmas Eve, 1814, was received in Philadelphia. Mayor Wharton of that city announced that a general illumination of Philadelphia would take place on the evening of February 15, on which occasion it is recorded that "Paul Beck's shot tower, near Arch street and the Schuylkill river, rose up like a pillar of fire, the top being crowned with 160 lamps."

The owner of the tower advertised when he constructed it, that he had "erected a patent shot factory upon as large a scale as any in Europe." This tower was more than 170 feet high, was very complete in its equipment and chiefly used lead found in Louisiana and shipped from New Orleans. It was said to be capable of supplying the entire United States with shot.

Thomas Sparks' shot factory, sometimes known as the Soothwork Shot Tower, was long one of the landmarks of Philadelphia. It was in Carpenter street and founded in 1808 by Cousland, Bishop & Sparks, whose patent shot long was celebrated.

Baltimore Had High Place

Baltimore upheld its manufacturing reputation in regard to shot towers along with rival cities. Gay street shot tower stood on the west side of North Gay street in 1823. It was raised 187 feet above ground by Jacob Wolfe, builder, under direction of Col. Joseph Jameson, president of the

company. Scharf states that this shot tower was taken down in January, 1845.

Gist's shot tower on Eutaw street, between Conway and Barre streets, was torn down in March, 1851, and the bricks were used in the building of five warehouses on the south side of Baltimore street, between Eutaw and Paca streets. William Gist, according to the directory of 1831-1833, was proprietor of the Eagle Lead Works, southwest corner of Eutaw and Conway streets.

All were interesting shot towers, but only the Phoenix Shot Tower of Baltimore City survives. The fact that it was familiarly called the Merchant's Shot Tower indicates that many business men of Baltimore were stockholders in the plant.

The Structure

Niles' Register under date of December 27, 1828, copies from current daily papers the following:

"The circular brick tower erected by the Phoenix Company, for making shot at the corner of Front and Pitt (Fayette) streets, has reached the intended elevation, being 234 feet 3 inches high from the pavement. Its diameter at the bottom is 44 feet and at the top 20. The stone foundation wall is 10 feet thick at the bottom and 6 at the top.

"The brickwork, which commences at the surface, is 5½ feet thick, of which thickness it continues for the height of nearly 50 feet, when it diminishes four inches in every story, being 20 inches thick at the top of the parapet, 3 feet in height, which crowns the summit.

"This huge structure, which is an excellent piece of brickwork, was commenced on the 2d of June and finished on the 25th of November (1828) and was built without scaffolding. The parapet at the top is white and somewhat resembles in its appearance a mural cown, and, as the tower is well proportioned, the whole edifice is an ornamental feature in the prospect of the city.

"There are now two shot towers in this city, capable of making a mighty quantity of shot of all sizes and of the very best quality."

The large sizes of shot, from B to 3T, inclusive, were dropped from the highest floor, which was reached by a spiral staircase of 310 steps. The smaller numbers were dropped from the middle floor. The sizes of the shot were carefully graded by fixed standards and were mathematically perfect.

The manufacturing capacity of the plant was 100,000 bags in a season, which could be increased readily to 200,000 every six months or, if necessary, to half a million, annually."

Method of Manufacture

A copy of Ballou's Pictorial Drawing Room Companion of nearly a century ago gives this account of the construction of the tower and of methods of manufacturing shot:

"The famous Merchants Shot Tower at the corner of Front and Fayette Street, Baltimore, was formerly called the Phoenix Shot Tower. The corner stone was laid by that venerable patriot Charles Carroll of Carrollton, June 2, 1828, he being the last survivor of the immortal band of signers of the Declaration of Independence. The structure is of brick and raises 246 feet above the surface of the ground. Visitors are permitted to ascend by the spiral staircase to the summit from which a magnificent view of the City of Baltimore and its environs is obtained.

The process of manufacturing shot commences with hoisting up the lead by an endless chain or windlass driven by steam. It is then melted in kettles at the various dropping stations, alloyed and prepared for dropping. An iron handle, or holder, is then hung over the hatchway, which is open from bottom to top and in this handle is placed a box with the bottom perforated with holes of the size of the shot to be manufactured. The descending streams separate into globules of exactly spherical form which are cooled by their passage through the atmosphere and finally fall into a reservoir of water.

From the water tank the shot is raised by a ladle or machinery and passes into the drier where it is thoroughly dried and thence to the polishing cask or cylinder where a little black lead is added and a swift rotary motion soon produces a high polish. Through an aperture the shot now passes into a receiving box, thence to the finishing room, thence to inclined planes which separate the perfect and the imperfect, the former running freely down the troughs, while the latter remain at the head and sides. The imperfect shot are melted over again. The good shot are received in a box at the end of an inclined table and then pass to the sifting case which contains a series of sieves of different sizes, the largest at the top. As the shot descends each sifter receives such as suits its size. The assorted shot are then put in boxes or tubes, are finally weighed out into bags of 25 pounds each and are then ready for distribution to the trade.

Buckshot are made by moulding or compression and all small shot by dropping. There are some half a dozen shot towers in this country consuming annually from 150 to 200,000 kegs of lead and turning out 5,000 tons of shot. The Merchant's Shot Tower is the tallest in the world, that of Villach in Corinthia, which is quite noted, being only 240 feet high. The metal is melted in the Baltimore tower at different degrees of elevation. Lead alone is not adapted to the purpose but arsenic and other metals are combined with it to give the quality of forming readily into globules. The largest shot are dropped from the greatest elevation. We advise no person who is ever troubled with vertigo to ascend to the top of this tower; on those of weak nerves the position is a very trying one. Yet a few years since when the vane required to be taken down for repairs, a sailor ascended the spire and brought it down with as much coolness as if he had been merely going up and down the side ladder of a ship. Of the other shot towers in the United States a quite noted one stands on the island of New York, on the banks of the Hudson River about five miles from the city and forms a conspicuous feature in the landscape on approaching New York from the Sound. Its altitude is considerably less than that of the structure delineated here, still from its summit, owing to the level nature of the surrounding region, an extensive view is obtained disclosing a panorama of much natural beauty and picturesque effect."

Thus is passing from the stage of commercial and historical activity a group of famous old structures whose important part in the development of our great land is little sung and seldom thought of. Their passing emphasizes the tremendous progress we have made in the field of shot making as in almost every other branch of ordnance manufacture.

The old Baltimore Shot Tower is more than a local landmark—it is a national monument to men and times that stand high in our national life. It is the lone survivor of a fallen race and should stand—a symbol of our first efforts in American Ordnance.

Editorials

The Sixth Annual Meeting

THE Sixth Annual Meeting of the Army Ordnance Association at Aberdeen Proving Ground, October 3, 1924, was a most auspicious and enthusiastic affair. A complete account of it will be found elsewhere in these pages. Suffice it to say here that the interest and cooperation displayed on all sides—by industry, by science, and by advocates of industrial preparedness everywhere—is most encouraging and augurs well for the future of our national defense.

The meeting was devoted largely to the chemistry of ordnance. The participating societies were composed mostly of chemists. The emphasis placed upon the chemical features of ordnance development were accepted and concurred in in an whole-hearted fashion.

That chemistry is vital to ordnance is a truism. It is hoped that, by this meeting, the bonds of cooperation and mutual understanding have been strengthened so that the chemists of the country, upon whom rests the responsibility of chemical preparedness, may know and understand the vital correlation between the test tube and the explosives of ordnance.

New National Headquarters

THE National Headquarters of the Army Ordnance Association are now located in the Mills Building, 17th Street and Pennsylvania Avenue, N. W., Washington, D. C.

In making this announcement we wish to remind all members that the latch string is always out. When in Washington, come in and make the offices of the A. O. A. your headquarters. The office of the Secretary wants to be of service whenever it can. Its assistance in all matters within its sphere is yours for the asking. Make use of it!

A Vital Subject

IN his report to the President for the year 1924, the Secretary of War has this to say on the important topic, "Reserve Ammunition:"

"While it is true that ample stores of ammunition have been retained since the war as a reserve in conformity with sound military policy as provided by congressional action, these stocks can not last indefinitely. They are subject to depletion of two sorts. They are reduced year by year as a result of the normal amount of firing carried on in target practice to insure training in marksmanship. They are likewise reduced by normal deterioration. In fact, even if there were no target practice, the ammunition reserve would all be unsafe in 1939, as the ordnance experts give 20 years as the safe life of the artillery ammunition manufactured during the war. The fundamental requirement is to maintain a proper war reserve. The next question is to determine the most economical method of retaining that reserve in an efficient condition.

* * * * * * *

The reserves should be kept at a minimum, for we must be economical; nor can we build them up immediately, for we must distribute our expenses. But it is essential that they be built up to normal size at a nominal rate if our forces are to function efficiently when they enter a theater of active operations.

"The replenishment of the ammunition reserve should be commenced in the near future."

Who's Who in This Issue

WE take pleasure in presenting in this issue: Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., who in his discussion of "Modern Ordnance," gives a complete and authentic account of the present status of development of American Ordnance.

Capt. John B. Bellinger, Jr., of the Ordnance Office, who tells of the Ordnance activities on September 12, 1924, in his article on "Defense Day in the Ordnance Districts."

Maj. R. L. Maxwell, of the Supply Division, Field Service, Office of the Chief of Ordnance, who describes his experiences in staging "Ordnance Demonstrations" while in command of the Mulheim Ammunition Depot, American Forces in Germany, and at the training camps at Camp McClellan, Alabama.

Maj. J. S. Hatcher, of Frankford Arsenal, who served as Ordnance Officer at the recent Camp Perry matches and who discusses the important relation between ordnance and the annual rifle matches in his article, "Ordnance and the National Matches."

Col. T. L. Ames, Ordnance Officer, Second Corps Area, who, assisted by Mr. A. L. Terwilliger, of the armament section of that Area, describes the official tests of the guns recently emplaced at Fort Tilden, N. Y., in the article "New 16-inch Guns Guard Metropolis."

Maj. Glen P. Wilhelm, Chief of the Infantry and Aircraft Armament Division, Office of the Chief of Ordnance, who describes the 1924 National Rifle Matches at Camp Perry.

Col. F. E. Wright, of the Carnegie Institution; Col. G. F. Jenks, Commanding Officer at San Antonio Arsenal, and Dr. Hermann Kellner, of the Bausch and Lomb Optical Company, who contribute to a symposium on "Optical Glass and Fire Control Instruments."

Capt. Arthur B. Domonoske, associate professor of experimental engineering and director of shops at the University of California, who writes on "Army Ordnance at the University of California."

Mr. G. W. Jones, of the chemical staff of the Bureau of Mines Experiment Station, Pittsburgh, who contributes Report IV of the Committee on Explosibility of Ammonium Nitrate in his article, "The Influence of Temperature Upon Explosibility of Ammonium Nitrate."

Reserve Corps Notes

Items of Interest to Members of the Ordnance Section, O. R. C.

Compiled by Major John A. Brooks, Jr., Military Personnel Section, Office of the Chief of Ordnance

IT is desired to make this section of ARMY ORDNANCE a source of information for reserve officers on all matters relating to appointments, assignments, training courses and other topics of interest. It is also desired to incorporate any news items of general interest regarding the activities of Reserve Officers. It would be appreciated if members of the Army Ordnance Association who learn of any items of general interest would send them to the Military Personnel Section, Office of the Chief of Ordnance, or to the Editor, ARMY ORDNANCE, in order that they may be considered for publication.

REGULATIONS for the Officers' Reserve Corps are at present being revised. Qualifications for promotion are being prescribed more in detail. It is expected that this will enable qualified officers to be promoted with more facility and that it will prevent the promotion of those who are not qualified or do not take the proper interest. Information regarding the new requirements for promotion should be available for publication in the next issue of ARMY ORDNANCE.

FUNDS are still available for the training of a number of officers of the B. A. Group during the present fiscal year. It is not contemplated that any large training camp will be conducted, but that officers will be trained in small groups at their places of assignment, or at the arsenals. It is suggested that officers who desire training before June 30, 1925, apply to their places of assignment in order that they may be considered, and that they state what time would be most convenient. Chiefs of sections of the Ordnance Office, Commanding Officers of Arsenals and other establishments, and Chiefs of the District Offices will be asked for recommendations as to the places, time, and names of officers to be trained. It is contemplated that, unless especially excused, or unless, for the convenience of the government, an officer has not been ordered to active training, a period of 15 days active training in each grade will be a requirement for promotion. The majority of officers who were trained this year are anxious to receive more training in the future. An attempt is being made to make the training interesting and of real value from a professional and recreational, as well as from an ordnance, standpoint. Arrangements will be made to have the training at such places and at such times as will be most convenient for the officers concerned.

LIEUT. ROY S. HAGGARD, Ord. ORC., Manchester, N. H., has applied for training at Watertown Arsenal during the last two weeks of December. His request has been approved.

ON Defense Day, Major Jeremiah Campbell, of Boston, gave an interesting talk to officers assigned to the Boston District Office on the subject of the Reserve Officers' Camp held at Aberdeen Proving Ground in August of this year. His talk was published in the September number of *Tenney Service*.

Recently Commissioned Ordnance Reserve Officers

THE following have accepted reserve commissions since the last issue of ARMY ORDNANCE.

Lieut. Col. Elmer E. Ware, Ord. ORC., 319 Westminster Ave., Detroit, Mich.

Major Albert W. Draves, Ord. ORC., 1284 Stowell Ave., Shorewood, Milwaukee, Wis.

Major George W. Morrison, Ord. ORC., P. O. Box 146, Latrobe, Pa.

Capt. L. A. Codd, Ord. ORC., 1906 N St. N.W., Washington, D. C.

Capt. Edwin G. Davis, Ord. ORC., 7 Glenbrook Ave., Yonkers, N. Y.

Capt. Charles H. Edwards, Ord. ORC., c/o Insurance Commissioner, Cheyenne, Wyo.

Capt. John Finch, Ord. ORC., 215 Quitman St., Denver, Colorado.

Capt. Ernest L. Lucas, Ord. ORC., A. & M. College, Miss.

Capt. George J. Schladt, Ord. ORC., 217 West Blackwell St., Dover, N. J.

1st Lieut. Louna W. Holland, Ord. ORC., 3 Parker Ave., Cherrydale, Va.

1st Lieut. Edmund F. Jewell, Ord. ORC., c/o Union Leader, 48 Hanover St., Manchester, N. H.

1st Lieut. Harry H. Needham, Ord. ORC., Erie Ord. Reserve Depot, Erie Proving Grd., LaCarne, Ohio.

1st Lieut. Gordon C. Tibbitts, Ord. ORC., 321 Essex Ave., Chevy Chase, D. C.

1st Lieut. Clifford B. Potter, Ord. ORC., 5435 Michigan Ave., Chicago, Ill.

1st Lieut. Russel A. Rose, Ord. ORC., 4428 Hall St., Dallas, Texas.

2nd Lieut. Dennis W. Brosnan, Jr., Ord. ORC., 242 Pine St., Albany, Ga.

2nd Lieut. Edward L. Cox, Ord. ORC., Y. M. C. A. Appleton, Wis.

2nd Lieut. Allen M. Crain, Ord. ORC., 5811 Glenview Ave., Cincinnati, Ohio.

2nd Lieut. Thomas J. Day, Ord. ORC., 527 Lamar Ave., Selma, Ala.

2nd Lieut. Herbert S. Freeman, Ord. ORC., 31 S. Prado St., Atlanta, Ga.

2nd Lieut. Clarence Jensen, Ord. ORC., 221 11th St., Racine, Wis.

2nd Lieut. Herbert S. Karch, Ord. ORC., U. S. Bureau of Mines, 4800 Farbes St., Pittsburgh, Pa.

2nd Lieut. Paul F. Mumma, Ord. ORC., 312 Foch St., Ellwood City, Pa.

2nd Lieut. Henry E. Passmore, Jr., Ord. ORC., 605 Wayne Ave., Elwood City, Pa.

2nd Lieut. Raymond S. Potter, Ord. ORC., 430 Douglas St., San Diego, Cal.

2nd Lieut. William V. Sestok, Ord. ORC., 2424 Elmhurst Ave., Detroit, Mich.

2nd Lieut. John Slezak, Ord. ORC., 156 North Oak Park Ave., Oak Park, Ill.

Recently Reappointed Ordnance Reserve Officers

THE following reserve officers have accepted reappointment in the Ordnance Officers' Reserve Corps:

Col. David C. Seagrave, Ord. ORC., 605 Market St., San Francisco, Cal.

Lieut. Col. James Guthrie, Ord. ORC., 300 St. Clair St., Elyria, Ohio.

Lieut. Col. Aaron L. Mercer, Ord. ORC., 11 East 36th St., New York, N. Y.

Lieut. Col. Nathaniel C. Walpole, Ord. ORC., 1000 Glenn Iris Ave., Birmingham, Ala.

Major Charles A. Barton, Ord. ORC., 1216 Chestnut Ave., Wilmette, Ill.

Major Jesse D. Burks, Ord. ORC., 1825 Highland Place, Berkeley, Cal.

Major Edmund E. Chapman, Ord. ORC., 1504 Filmore St., Topeka, Kans.

Major Charles Davenport, Ord. ORC., Ordnance Department, Corazol, C. Z.

Major Maurice M. Osborne, Ord. ORC, 297 Marlboro St., Boston, Mass.

Major Alfred E. Perkins, Ord. ORC., 308 Kearns Bldg., Salt Lake City, Utah.

Major Henry W. Pfeffer, Ord. ORC., 202 Barrie Road, Narberth, Pa.

Capt. Charles T. Burgess, Ord. ORC., Box Lilac & Florence, Webster Grove, Mo.

Capt. William A. Chenoweth, Jr., Ord. ORC., 2539 Aberdeen Rd., Birmingham, Ala.

Capt. Paul B. McConville, Ord. ORC., Fort Pierce, Fla.

Capt. Charles G. Moses, Ord. ORC., 7 East 42nd St., New York, N. Y.

Capt. Carroll A. Parnell, Ord. ORC., Front and Freeman Sts., Cincinnati, O.

Capt. Joseph O. Sanders, Ord. ORC., 141 Rutledge Ave., Charleston, S. C.

Capt. Charles F. Wetherbee, Ord. ORC., 111 Brownell St., New Haven, Conn.

1st Lieut. George W. Brown, Ord. ORC., Camp John Hay, P. I.

1st Lieut. John P. Duke, Ord. ORC., 3605 Colonial Ave., Dallas, Tex.

1st Lieut. Malcolm K. MacPhail, Ord. ORC., 415½ Park Ave., Muscatine, Iowa.

2nd Lieut. Harold W. Baron, Ord. ORC., Woodmere, L. I., New York.

2nd Lieut. Sam W. Burke, Ord. ORC., 2115 Vermont Ave., Los Angeles, Cal.

2nd Lieut. Francis S. Earnshaw, Ord. ORC., 1326 So. High Ave., Freeport, Ill.

2nd Lieut. Harold S. Flanders, Ord. ORC., 1620 Plainfield Ave., Grand Rapids, Mich.

2nd Lieut. Chester H. Hartmann, Ord. ORC., 3822 N. Ridgeway Ave., Chicago, Ill.

2nd Lieut. Freeman G. James, Ord. ORC., Apt. 51, 114 21st St., Elmhurst, L. I., N. Y.

2nd Lieut. Carl H. Johnson, Ord. ORC., 5122 N. Leavitt St., Chicago, Ill.

2nd Lieut. Richard P. Jones, Ord. ORC., 1563 Maryland Ave., Covington, Ky.

2nd Lieut. Lawrence M. Middlemas, Ord. ORC., 1717 E. 30th St., Cleveland, O.

2nd Lieut. Arthur F. O'Brien, Ord. ORC., c/o Immigration Office, Vanceboro, Me.

2nd Lieut. Everett E. Robie, Ord. ORC., 10 Church St., Manchester, Mass.

2nd Lieut. Raymond J. Schulte, Ord. ORC., 1973 Waterloo St., Detroit, Mich.

2nd Lieut. Louis A. Waldner, Ord. ORC., 708 11th St., Middletown, Ohio.

2nd Lieut. Hamilton T. Walker, Ord. ORC., 1225 Widener Bldg., Philadelphia, Pa.

2nd Lieut. George D. Wickman, Ord. ORC., Apartment 6, 1324 Pine St., San Francisco, Calif.

Recently Assigned Ordnance Reserve Officers

THE following reserve officers have been recently assigned as indicated after their names:

Col. John O. Johnson, Ord. ORC., 2415 20th St. N.W., Washington, D. C., Manufacturing Service, Executive Division, Washington, D. C.

Major Charles E. Ellis, Ord. ORC., Mahwah, N. J., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

Major John L. Hughes, Ord. ORC., Troy Club, Troy, N. Y., Manufacturing Service, Watervliet Arsenal, Watervliet, N. Y.

Major Annesley D. Smith, Ord. ORC., 26 Chester St., Mt. Vernon, N. Y., Manufacturing Service, New York District Ordnance Office, New York.

Capt. Richard C. Bodenhamer, Ord. ORC., 214 Chicago Blvd., San Antonio, Tex., Field Service, San Antonio Arsenal, San Antonio, Tex.

Capt. Arthur B. Domonoske, Ord. ORC., 1144 The Alameda, Berkeley, Cal., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.

Capt. Walter S. Frost, Ord. ORC., Box 335, Durham, N. H., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

Capt. Herbert B. McKahin, Ord. ORC., 923 16th St., Moline, Ill., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.

Capt. George J. Schladt, Ord. ORC., 271 West Blackwell St., Dover, N. J., Manufacturing Service, Picatinny Arsenal, Dover, N. J.

Capt. Fred R. Zimmerman, Ord. ORC., 1521 East 65th St., Chicago, Ill., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

1st Lieut. Louna W. Holland, Ord. ORC., 3 Parker Ave., Cherrydale, Va., Field Service, Pig Point Ordnance Reserve Depot, Pig Point, Va.

1st Lieut. Robert E. Pate, Ord. ORC., 216 Fort Washington Ave., New York, N. Y., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

2nd Lieut. Edward B. Allen, Ord. ORC., 18 Putnam St., Bristol, Conn., Manufacturing Service, Springfield Armory, Springfield, Mass.

2nd Lieut. Wellner L. Christian, Ord. ORC., 15 T St. N. E., Washington, D. C., Manufacturing Service, Artillery Division, Washington, D. C.

2nd Lieut. Herbert S. Freeman, Ord. ORC., 31 S. Prado St., Atlanta, Ga., Field Service, Augusta Arsenal, Augusta, Ga.

2nd Lieut. Ernest W. Greene, Ord. ORC., c/o Coronet, Plant City, Fla., Manufacturing Service, Nitrate Plant, Muscle Shoals, Ala.

2nd Lieut. Harry L. Lauby, Ord. ORC., 1305 Sol Ruby St., Philadelphia, Pa., Manufacturing Service, Philadelphia District Ordnance Office, Philadelphia, Pa.

2nd Lieut. James W. Longueuil, Ord. ORC., 85 Woodmont St., Mittineague, Mass., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Mass.

2nd Lieut. Paul F. Mumma, Ord. ORC., 312 Foch St., Ellwood City, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

2nd Lieut. Henry E. Passmore, Jr., Ord. ORC., 605 Wayne Ave., Ellwood City, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

2nd Lieut. William E. Sickel, Jr., Ord. ORC., 804 West 41st St., Savannah, Ga., Manufacturing Service, Nitrate Plant, Muscle Shoals, Ala.

2nd Lieut. Frank W. Smalley, Ord. ORC., Nu-Grape Co. of America, Nelson St., Atlanta, Ga., Manufacturing Service, Nitrate Plant, Muscle Shoals, Ala.

Capt. Charles H. Edwards, Ord. ORC., c/o Insurance Commissioner, Cheyenne, Wyo., Territorial Assignment Group.

Capt. John Finch, Ord. ORC., 251 Quitman St., Denver, Colo., Territorial Assignment Group.

1st Lieut. Edmund F. Jewell, Ord. ORC., c/o Union Leader, 48 Hanover St., Manchester, N. H., Territorial Assignment Group.

1st Lieut. Russell A. Rose, Ord. ORC., 4428 Hall St., Dallas, Tex., Territorial Assignment Group.

2nd Lieut. Thomas J. Day, Ord. ORC., 527 Lamar Ave., Selma, Ala., Territorial Assignment Group.

2nd Lieut. Raymond S. Potter, Ord. ORC., 430 Douglas St., San Diego, Cal., Territorial Assignment Group.

Reserve Corps Strength

DURING the last twelve months the strength of the Officers' Reserve Corps—all branches—has been increased by 3,770. All Corps Areas report increases in Reserve Officers, with the exception of the Second and the Fifth, where there have been slight decreases. The Eighth Corps Area made the largest gain, with an increase of 1,114.

New York has the most Reserve Officers, with 8,329; California is second with 5,021; Illinois is third with 5,016; Pennsylvania is fourth with 5,000; Massachusetts is fifth with 3,575; Ohio is sixth with 3,096; Texas is seventh with 3,041; Michigan is eighth with 2,189; New Jersey is ninth with 2,152; and Missouri is tenth with 2,144. A year ago the states rated in this particular as follows: New York first; Pennsylvania second; California third; Illinois fourth; Massachusetts fifth; Ohio sixth; Texas seventh; New Jersey eighth; Michigan ninth; and Missouri tenth.

General Nolan to Reserve Officers

THE following excerpts from an address by Brig. Gen. Dennis E. Nolan, Deputy Chief of Staff, before the Reserve Officers' Association, at Columbus, Ohio, October 25, 1924, should be of interest:

NECESSITY FOR TRAINING

"I think the position of the Secretary of War regarding the necessity for training of the officers of the Organized Reserve is well known, as he has officially stated as his opinion that as a minimum, practical training of two weeks annually should be given to one-third of the officers of the Organized Reserves. The War Department believes that we must obtain such increased appropriations annually that we can secure a moderate increase in the number of officers trained in the Organized Reserves, and also a moderate increase annually in the number of men trained in the Citizens' Military Training Camps, the Reserve Officers Training Corps units and in the National Guard. I should point out here a very practical difficulty which confronts the War Department and the Government, which latter is faced with the problem of balancing its budget annually and seeing that expenditures do not exceed income. I should point out that while the War Department will continue to strive for a moderate increase in those civil components, it is faced with annual decreases in appropriations. For instance, the figures for the past four years have been—for 1922—$365,000,000; for 1923—$279,000,000; for 1924—$257,000,000; and for 1925, the fiscal year we are now in, $255,000,000.

"In spite of these decreasing appropriations the number of people desiring training has been increasing. We have been helped out up until now by the fact that we could draw on surplus supplies left over from the World War—clothing, ammunition for target practice, etc. These stocks are becoming rapidly exhausted, in some respects are now completely exhausted, so that the necessity for increase in appropriations, regardless of whether we further increase the personnel to be trained, is a subject for immediate and serious consideration. The question will be asked if a more economic administration of our funds would not enable us to enroll and train a larger number of men with the same appropriation. I have until recently been in charge of the Supply Division of the General Staff, where I had an opportunity to look into the expenditures of funds and generally the economic system in the administration of funds. I wish to tell you that the Secretary of War takes great personal interest in all economic questions affecting the Army. All expenditures for repairs, building, alterations, and work of that character wherever the cost will exceed $500 are by his orders sent through the Supply Division of the General Staff and submitted to him for his personal approval. I do not know when we have ever had such a careful and economical administration of the War Department, and I seriously doubt if, outside of a few minor particulars, any great amount of money can be saved from our appropriation, or any funds spent in a more advantageous way than at present. That being the case, if we are to make progress instead of stagnate, our only solution is to obtain increased appropriations of money, not all at once, but by gradual increments year by year.

"On the other hand, as citizens, we are only too well aware that the Government must have a balanced budget, and that the trend of the times is towards reduced taxation and hence a reduced budget.

"The War Department feels that a wise administration of the budget law will enable the Government, through economies effected by this law in all Departments, to make available more funds for expenditures for the national defense. It is well known to you that more funds will be needed even under a very moderate program of development of the civilian components of the Army under which the War Department is progressing.

DEVELOPMENT UNDER NATIONAL DEFENSE ACT

"We have been developing our citizen army under the National Defense Act. While the Regular Army has been stationary, we have been expanding the National Guard, Reserve Officers' Training Corps, Citizens Military Training Camps, and the training of our Reserve Officers. We have been doing this by making as much as possible out of our budget allotments.

"You may be interested in knowing exactly how we go about this. In order that you may understand our financial methods, and also know the process through which allotments of funds go, including your Reserve training funds, perhaps it will be worth while for me to explain the successive steps as they occur. First, the estimating services are furnished a program on which to base their detailed estimates. This program is carefully considered by the Advisory Council on Legislation and by the Chief of Staff and Secretary of War before it is sent to the estimating services. The estimating services under the program present their needs to what is known as the Budget Advisory Committee. This Committee conducts an exhaustive hearing into practically every item of the Appropriation Bill which is being estimated for. As a result of these prolonged hearings, this Budget Advisory Committee submits a report which is again considered by the Advisory Council, revised or modified, then submitted to the Chief of Staff, who transmits it to the Secretary of War with his recommendations.

"After being again modified by these recommendations, this estimate is sent to the Director of the Bureau of the Budget as the preliminary estimate of the War Department. The director of the Bureau of the Budget considers this preliminary estimate in detail. He finally returns the estimate for revision, at the same time indicating what will be the limiting figure, under the financial program of the President announced during the Business Meeting of the Government.

"The process I have already indicated as having been gone through when the War Department preliminary estimate was drawn up, is again repeated. The final War Department estimate is then transmitted to the Bureau of the Budget in the form of a primary and a supplemental estimate, the primary estimate coming within the limiting figure stated by the Bureau of the Budget.

"I feel that your interest in these matters entitles you to know that the funds provided for the support of the Reserve project in the 1926 estimates amount to $3,995,690, or $715,000, more than the amount of the 1925 appropriations for this purpose. Including expenses incident to overhead and operation, this estimate, if approved, will permit active duty training for fifteen days of approximately 16,000 reserve officers, exclusive of National Guard officers holding reserve commissions who have no relation to the project.

"In the supplemental estimate are included those items which could not be included in the primary estimates because of the limiting figure set by the Director of the Bureau of the Budget, but which are considered vital by the Secretary of War for a moderate progress in carrying out the provisions of the National Defense Act. The Director of the Bureau of the Budget then conducts hearings for all services concerned in the expenditure of funds requested. These hearings this year have been very detailed and are still in progress, and it is too early to see what the final result will be. By that I mean we cannot yet tell because it is not known how much of the money we placed in the supplemental estimate will be added to our primary estimate by the Director of the Bureau of the Budget.

"The effort to obtain greater consideration does not stop there, as each Cabinet member as a rule makes a personal appeal to the President to have the amounts made his Department increased. When the final decision has been made by the President and the Budget transmitted to Congress by the President then, as you know, all the Services appear before the subcommittee of the Committee on Appropriations and attempt to establish their claims for the amounts transmitted by the President to Congress. These hearings are again repeated before the Senate, the final amount that any Department is to get being acted upon in conference between the Senate and House.

"From the brief outline I have given you, it is very easy to see that every item has been scanned again and again. If there is any possibility of postponing action to the future, action is postponed until the following year. The pressure for economy is very great. Usually all that is appropriated is the minimum amount that the Army needs merely to exist. It is only by the most Spartan methods and the most ingenious application of what we get, that we have been able to make what progress we have under the National Defense Act.

"I am giving you the general outline of the procedure because I think you should be familiar with it. In your communities, as people are liable to talk loosely about extravagance in administration or about huge appropriations for the War Department, you should know that the procedure under the Budget Act and imposed by the Budget law and enforced by the Secretary of War makes it impossible for any extravagance to occur in the administration of the appropriations of the War Department.

"There has been discussed for some time the problem of the proper housing of that part of the Regular Army still sheltered in the war-time cantonments; the needs for repairs to permanent buildings and structures at our military posts and stations; the War Department Aviation program, and the fortifications at Panama and Hawaii.

NECESSITY FOR ADEQUATE AMMUNITION RESERVE

"These problems are more or less well known to you. I need only mention them. I wish, however, to discuss with you for a few minutes an additional problem that is giving the War Department serious concern. It will be new to most of you, because it has not as yet been discussed outside of the War Department. It is the problem of providing and maintaining an adequate ammunition reserve. The experts in our Ordnance Department have estimated that our artillery ammunition now in reserve, which was made during the war, has a useful life of about twenty years. That is to say our present stocks, however large or small they may be, will be unreliable by 1938. The War Department General Staff has determined what our minimum ammunition reserve shall be. The question now is how to finance the proposition.

"The value of the ammunition needed to provide this minimum reserve is approximately $340,000,000. It is proposed that the most economical method of financing

would be to secure annual appropriations of $17,000,000 over a period of twenty years.

"The amount contemplated for the reserve is not large. You will readily understand its relative size when I tell you that the French fired practically the value of that amount of artillery ammunition in the battle of Malmaison in the fall of 1917, and that we fired approximately the same amount of artillery ammunition during the battle of the Meuse-Argonne.

"The necessity of maintaining a reserve of this size becomes apparent when we realize that the Ordnance calculations show that production of artillery ammunition in any large quantity cannot be expected before the end of the twelfth month after a declaration of war. We must bridge the gap of twelve months by using the artillery ammunition we have in reserve. Our reserve must be large enough for that.

"In spite of the pressing nature of this problem, rendered more pressing each day as our reserve stocks deteriorate, we have been unable to put any appreciable item in the budget for such a reserve. We did insert a figure of $25,000 for this purpose this year, and we inserted that figure, not because we thought that amount of money would be of any help at all in solving the problem, but simply because such an item would enable the Chief of Ordnance to bring the matter to the attention of Congress during the hearings on the next appropriations bill. A full consideration cannot longer be delayed.

"An estimate of the amount of ammunition needed for target practice by the units of the Regular Army, National Guard, Organized Reserves, Citizens' Military Training Camps, and Reserve Officers Training Corps units as they now exist would require the annual use of ammunition to the value of approximately $11,000,000. The plan that will be suggested to Congress will be that they begin in the near future to appropriate at least that amount annually. At the same time, we would use the old ammunition, and put aside the new to serve its purposes as a war reserve for the twenty years of its accuracy life. Holding the new in reserve while we shoot away the deteriorating war stocks is the most economical way of financing the dual problem of target practice allowances and the maintenance of a reserve.

"It is necessary that action be taken on this problem before our deterioration pyramids and what we now have becomes useless for any purposes at all. Until 1938, we will have plenty of 75-mm. shell, but after 1934 we will have to begin to buy shrapnel for target practice. You can see from these dates that the problem is an important and a pressing one. I mention the problem to you now in order that as an Association and as individuals you may during the next year give it serious thought. Its correct solution is vital to the National Defense."

Reserve Officers in Berkshire County, Mass.

FIFTY members of the Berkshire Unit, Reserve Officers Association, gathered for the monthly meeting and dinner at the North Adams Y. M. C. A. on Saturday, October 11th, with Colonel J. Tracey Potter, of North Adams, as host. Colonel William H. Eaton, F. A. ORC., President of the unit presided, and spoke enthusiastically of the fine and helpful spirit of Regular Army officers in their constant efforts to co-operate with the Reserve Corps.

Colonel Eaton welcomed the distinguished Chief of Staff of the 1st Corps Area, Colonel Charles Romeyn, Cavalry, U. S. A., and the latter spoke briefly of the purposes of cavalry in modern warfare. He invited attention to the little known, but vitally important, part that mounted troops took in the World War, and predicted confidently that the horse would figure more significantly in wars of the future.

Lt. Col. Allen L. Briggs, Signal Corps, U. S. A., lately returned from duty as military attaché in Austria and Czecho-Slovakia, read an excellent paper on the new military policy and emphasized his belief in adequate military preparations as the only safeguards for peace. He pointed to the unfamiliar fact that the U. S. Army has been called to action over a hundred times in its brief history, and deplored the more obvious fact that it never has been adequately prepared for service.

Major Stewart C. Godfrey, U. S. Engineers, gave an illustrated lecture on the great development at Muscle Shoals, Alabama. He referred in complimentary terms to the work of General Charles B. Wheeler, now of the Berkshire Unit, who was a member of the Army Board that first set about the establishment of a Government nitrate plant, and at the close of the lecture General Wheeler spoke briefly of that early work and expressed gratification at the present developments.

General Wheeler remarked upon the tremendous strides that have been made in military science and recalled the time, not so long ago, when he sat upon a board assembled for the purpose of developing the airplane as a potential engine of warfare. Fifty thousand dollars was the sum appropriated for the assistance of Prof S. P. Langley in his researches and operations. Today Langley Field, Virginia, is the model aviation field of the world and a monument to the great man who helped to make it possible.

In a short business session the Berkshire Unit voted to give a military ball in Pittsfield during the winter season. The November meeting and dinner will be held on Armistice Day, when the members will be the guests of Captain L. G. Treadway, of Williamstown, at the Ashfield House, Ashfield, Mass.

Lectures for New York District Ordnance Reserve Officers

ABOUT 110 Ordnance Reserve officers attached to the New York Ordnance District, together with manufacturers and engineers of the National Defense Section of the A. S. M. E., attended a lecture delivered by Brig. Gen. C. L'H. Ruggles, Assistant Chief of Ordnance.

The meeting was held in the Assembly Hall of the Engineers Building, 29 West 39th street, New York City, on Monday evening, October 20, 1924, and was presided over by Gen. Guy E. Tripp, Chairman of the Board of Directors of the Westinghouse Electric and Manufacturing Co.

It was the first of a series of lectures arranged by the New York Ordnance District, for the season 1924-1925, each of which will be delivered by an expert on the subject to be considered and presided over by a member of the Ordnance Advisory Board of the New York Ordnance District.

Professional Notes

AMMUNITION DIVISION

Exudation from TNT and Amatol

MOST field artillery shell, bombs, and certain ammunition for trench mortars are loaded with TNT or amatol. There are three different grades of TNT, varying in the amount of impurities present. Grade II TNT is generally used when the loading is straight TNT, but during the War Grade II TNT was used to mix with ammonium nitrate to produce amatol. The impurities present in TNT consist essentially of lower nitrated bodies, amounting in the case of Grade III TNT to 3 or 4 per cent, lesser amount being present in Grade II TNT. These mononitrotoluenes and dinitrotoluenes being chemically stable bodies, were not regarded at first as being particularly objectionable as their presence did not materially reduce the brisance of TNT.

The problem of exudation, particularly with high explosive shell, dates from within a year or so after the close of the War when reports were received, from certain depots located in the South, that an oily substance was observed to be exuding from the nose of some shells, despite the fact that all shell were provided with boosters or apparently tightly fitting screw plugs. Exudation was also reported in the case of some bombs.

Samples of this exudate were collected, and the question of its formation and the significance of its presence in shell has been the subject of an exhaustive study by Picatinny Arsenal, in consequence of which, some very definite data have been collected upon the subject.

Exudation of oil from TNT and amatol-filled ammunition is not the result of a chemical reaction and cannot, therefore, be considered an indication of the impaired stability of the explosive charge. The formation of this oil is purely a physical phenomenon resulting from the effect of a somewhat elevated temperature upon minute particles of TNT containing impurities, the net result being that the particles of TNT having the greatest percentage of impurities are melted to form small drops of oil. This oil is forced from the charge, either by the expansion of the explosive charge due to the increased temperature, or from some other cause, and passes through screw threads, appearing on the outside of the ammunition or in the booster as exudate. As amatol contains a certain proportion of ammonium nitrate, exudation is less extreme or is not apparent, due to the absorption of the oil by the ammonium nitrate.

This oil which exudes from TNT is explosive but is less sensitive than the TNT itself. The danger of such a condition lies generally, therefore, not in the explosive properties of the exudate, but in the decreased density of the charge, due to cavitation, making possible a premature explosion upon set-back when the shell is fired. There is also danger of premature due to the exudate with possible crystals of TNT being present in the screwthreads and being pinched between the screwthreads on firing the shell. It is also known that the TNT oils when present in the booster charge deaden the booster so that duds may result. It should be understood, however, that in most cases the presence of oil in a charge does not constitute a hazard unless the oil is forced out of the shell, causing cavitation in the charge, or, remaining in the screw-threads; and in these cases the danger does not exist in the storage of this ammunition but in firing it. The danger is practically negligible with bombs as these are simply dropped from the aeroplane; there is, however, a danger of bombs dropped "safe" exploding on impact. With trench warfare ammunition, since velocities are low, danger of premature due to cavitation, or exudate or TNT in the screwthreads is extremely remote.

The possibility of the formation of sensitive metallic salts by the action of the oil upon the shell body has been investigated, inasmuch as samples of the oil have been found to contain iron. Liquid TNT, placed in contact with metals, (copper, brass and steel), for 11 months, was found to form metallic compounds but these compounds were only slightly more sensitive than Grade A TNT. Further investigation showed that the iron compounds found in TNT oil are not the product of the reaction between the oil and iron, but are formed by the reaction between iron and the compound formed when alcohol acts upon TNT. Therefore, if alcohol be precluded from use as a purifying agent in TNT manufacture, and also is not used as a solvent for the shellac used to coat the booster cavity, there can be no possibility of the formation of metallic compounds with the TNT oil.

The presence of gas within TNT or amatol loaded ammunition has sometimes been noted. This gas is a reaction production of TNT and alcohol and is not due to the presence of other impurities. While gas is often found in exuding ammunition, the two phenomena are in no way related, and may exist entirely independently of each other, inasmuch as the former is the result of a chemical reaction, while exudation, as has been observed, is purely physical. The reaction, resulting in the formation of gas, is not progressive and will continue only so long as there is alcohol present. When all of the alcohol has reacted, the evolution of gas will cease and it is not reasonable to assume that there could be a sufficient quantity formed to rupture the container.

Exudation in TNT or amatol loaded ammunition therefore is not nearly so serious a problem from the standpoint of safety as is commonly supposed. This condition does not constitute a hazard as regards the storage of ammunition as the sensitiveness of the explosive has not increased. Any danger incurred exists in firing shell where premature may be obtained because of the pres-

ence of cavitation in the charge, or exudate in screw-threads. Danger with bombs and trench warfare ammunition is practically negligible. There is, however, a remote danger of explosion on unscrewing boosters from exuding ammunition, due to the possibility of explosive being pinched between the screw-threads.

It is, therefore, not desirable to issue shell showing definite exudation. There will, therefore, be accumulating stocks of shell showing exudation. These shell can be put in satisfactory condition by unscrewing the boosters (using safety precautions such as a barricade and simple equipment, the boosters being unscrewed by an operator outside of the barricade), swabbing out the booster cavity and screwing in freshly loaded boosters or satisfactory boosters from stock, the screwthreads of the shell and the booster being treated with glue, glue having been found to be the best substance to prevent exudate from passing through screwthreads. Shell in which exudation has been so extreme as to cause breaking down of the booster cavity will be set aside until such time as the contents of the shell can be removed and the shell reloaded with TNT at a Government Arsenal.

FRED HAWKES.

Use of Pyrotechnics by Air Mail Service

NIGHT flying by the Air Mail Service of the Post Office Department is being made safer by the use of pyrotechnics developed by the War Department. The particular danger incurred by aviators in night flying is in making a forced landing in the dark. A flare is being used which is mounted in a handy position in the plane so that it can be released without hesitation. As the flare falls from the plane, the flare candle with its parachute is pulled out of its case, and is at the same time automatically ignited. A light of 400,000 candle power is emitted during a period of three minutes, the flare slowly falling through the air during this period. The surrounding country is illuminated sufficiently to allow the aviator to choose a safe landing place. It is understood that serious accidents have already been obviated by the use of this flare. These illuminating flares were developed by the Ordnance Department for the Air Service of the Army and their value was at once utilized by the Air Mail.

The War Department is now developing for the Air Mail Service of the Post Office Department a ground light for use at landing fields for signalling to aviators the fact that they are flying into bad weather and should descend. This position light will be of 100,000 candle power, red in color and will burn for ten minutes.

Different colored signals for projection from the air planes and also signals for firing from the ground are now under consideration by the Air Mail Service of the Post Office Department, these signals being of the types used by the Air Service of the Army, and by the Infantry in sending messages.

FRED HAWKES.

ARTILLERY DIVISION

Status of Medium Artillery Materiel (Wheeled)

MEDIUM artillery is the artillery which accompanies the corps and has for its principal mission counter battery work, since the light artillery of the division does not provide for its own protection. This class of artillery has also the missions of extensive harassing and interdicting fire along the corps front and to a greater depth than the capabilities of the divisional artillery; also of destructive fire on strong points as well as on railway facilities and points of supply. For the accomplishment of these missions the Caliber Board considers that two distinct types of artillery are necessary. A gun and a howitzer. The gun should have a range up to 18,000 yards with a projectile not over 60 pounds and the howitzer a range up to 16,000 yards with a projectile not over 100 pounds. The weight of the piece limbered was desired to be less than 12,000 pounds as that is the maximum load which can be handled by the bridge materials of the corps. It was found that the 4.7-inch gun and the 155-mm. howitzer best meet these requirements.

The medium artillery matériel available during the World War and which is now on hand for our Service is—

	Type of Carr.	Trav. deg.	Elev. deg.	Range yds.	Weight lbs.
4.7" Gun, M. 1906	Single Trail	8	15	8860 (45-lb. shell) 7550 (60-lb. Shrap.)	8070
155-mm. Howitzer M. 1918 (Schneider)	Single Trail	6	42	12270	7600

The 4.7-inch gun, M. 1906, has too short a range for medium artillery missions. These ranges are those obtainable with the elevation premitted by the carriage. If elevated to 43° so as to obtain the maximum range, this gun would give a range of about 14,000 yards which is considerably less than desired.

Based upon the experience of the World War, the following experimental medium artillery matériels have been constructed with a view to the development of satisfactory artillry for corps use.

	Type of Carr.	Trav. deg.	Elev. deg.	Range yds.	Weight Firing Position lbs.
4.7-inch Gun Matériel, M1920E	Split trail	60	65	20200	13600
4.7-inch Gun Matériel, M1921E	Split trail	60	45	20200	10300
155-mm. Howitzer Matériel M1920E	Split trail	60	65	16390	13600
155-mm. Howitzer Matériel M1925E (under design)	Split trail	60	65	16390	13000 (Estimated)

Matériel, Model of 1920

As in the case of divisional matériel, an attempt was first made to mount the gun and howitzer on the same carriage, and two units were built of the 1920 model which mount interchangeably either one. The carriage is of the same general type as the 155-mm. G. P. F. gun carriage, M. 1918 with hydropneumatic controlled recoil. A quick return mechanism is provided to facilitate loading. A safety mechanism is provided to prevent fire when the cradle is not locked to the rocker. In order to equalize the loads on the carriage and limber wheels for traveling, the gun or howitzer may be retracted to a traveling position. The mechanism for changing the carriage from traveling to firing position is built into the axle and no separate jacks are required as for the G. P. F. for spreading the trail.

The trunnions are located near the rear end of the cradle, which results in a muzzle preponderance, and counter-balancing is required. This is effected through

two equilibrators mounted one on the front of each arm of the top carriage. Two types of equilibrator were constructed for test, one using springs and the other compressed nitrogen assembled at 600 pounds per square-inch pressure with the cannon horizontal. In order to permit the piece to be fired at high elevation with as shallow a pit as possible, the length of recoil varies with the elevation. At the maximum elevation the recoil shortens up to 36 inches, while at lower elevations the recoil is 48 inches.

As the weight of the unit with cannon and limber is over 15,000 pounds, it was necessary to provide a transport wagon to carry the gun or howitzer in order that the total weight for any one load would be below the maximum of 12,000 pounds. The wagon with cannon weighs approximately 9,000 pounds. A winch is provided on the body of the transport wagon, so that when the wagon is run up behind the cannon over the closed trails, the winch mechanism may be used to lift the trails, so as to align the body of the wagon with the slides of the cradle. Another winch is provided which rests in supports in the end of the wagon body to withdraw the howitzer from the cradle onto the wagon body.

It was determined from tests of this matériel that it is best to mount the gun and howitzer on carriages designed specifically for each. The 1920 model carriage is much heavier than is desired for a gun carriage, and is now being considered as a howitzer carriage only for the remainder of the test. This carriage has many defects, and it is not considered that it will be satisfactory for service use. Difficulty has been experienced in the strength of the top carriage, and while the carriage stood up under the firing program so far, it is not believed that it would be satisfactory for service use. One unit is now at Fort Bragg for service test. The other unit is at the Aberdeen Proving Ground.

Matériel, Model of 1921E and 1925E

With a view to providing a carriage specifically designed to mount a gun only, the 4.7-inch gun matériel, M. 1921, was designed and built. The carriage is of the same general type as the 1920 model. The total weight of the unit is much less, however, and the gun and carriage with limber weighs just below the total of 12,000 pounds. One unit of this matériel is now at the Aberdeen Proving Ground undergoing test. The carriage has a hydropneumatic controlled recoil with constant length of recoil of 48 inches. No quick return mechanism is provided on the gun carriage, as it has been considered that it may be loaded satisfactorily up to its maximum elevation of 45 degrees. The tests so far have indicated that this carriage is much superior to the 1920 model to mount the gun.

A new design is now being made of a carriage to mount a 155-mm. howitzer only. The general type of the carriage is the same as that of the 4.7-inch gun carriage, Model of 1921. The best features of the 1920 and 1921 model carriages are being included in this design. It is expected that the total weight of this unit in firing position will be approximately 13,500 pounds. The recoil mechanism will be of the hydropneumatic type with a constant length of recoil. The total elevation will be the same as for the 1920 model carriage. A quick release mechanism is considered necessary and will be included.

The progress of development to date indicates that for medium artillery it is preferable to provide a separate carriage for the gun and the howitzer. The matériel which has been built show definite superiority over World War types in regard to range and weight.

The 4.7-inch gun carriage in its tests so far has shown up very well. The matériel has not undergone a service test however. The test of the 1920 model howitzer indicated that further development was necessary for a howitzer carriage. The design for the second unit is now under way.

WM. C. YOUNG,
Major, Ordnance Dept.

INFANTRY AND AIRCRAFT ARMAMENT DIVISION

Discussion of Article on "Accuracy Firing" by Philip Schwartz in Army Ordnance Sept.-Oct. 1924

OFFICERS of the Small Arms Division of the Ordnance office were very much interested in reading the article on "Accuracy Firing" by Philip Schwartz in the ARMY ORDNANCE, issue of Sept.-Oct. 1924. It is believed that the author, through his lack of experience in small arms testing, is laboring under a misapprehension and has been led to make a number of misleading statements.

It is not intended to take issue with him particularly for larger caliber guns than small arms, regarding the general principle that an erosion test should be made at the longest range practicable, as it is agreed that the errors in muzzle velocity and the dispersion, due to a change in the ballistic coefficient, are the principal factors affecting the accuracy of a worn out gun. Also it is admitted that these errors are greatest at the longer ranges. It is known, however, that in the use of small arms ammunition at long range, other variations cause increases in dispersion out of all proportion in magnitude to the increases due to velocity and ballistic coefficient.

The author in his article on "Accuracy Firing" took particular exception to Item 3675 of the Ordnance Committee Minutes, which prescribes a service accuracy test for the rifle. This test is not in any way a true erosion test, but is a test which is made only by line troops. The object of the test was not to determine how many rounds a rifle barrel will fire before the accuracy is lost, due to erosion alone, but was for the sole purpose of allowing line troops a test by which they can determine whether a rifle barrel is accurate enough to be considered serviceable, due to any cause, such as rusting, pitting or wear due to either erosion or cleaning with abrasives. One of the principal reasons that a range of 500 yards or a longer range was no longer prescribed, in addition to the desirability of minimizing variations due to weather, was the fact that there were too many Army Posts and Stations where no ranges were available greater than 300 yards.

The recommendation that the firing test consist of only three targets of ten shots each was because it was not considered practicable to expend a larger amount of ammunition, the cost of which as compared to that of the barrel is far greater. It can readily be seen that if the rifle was considered already to be inaccurate before being submitted to the firing test, it could not be reasonably expected to fire very many more rounds before it became entirely inaccurate.

Machine rests were not prescribed for the test be-

cause they are not available for use of Line troops, and are unreliable when they are not operated by expert personnel. As a matter of fact, the use of the rifle in machine rests has been abandoned and is no longer used for ammunition tests in the selection of National Match ammunition. (In the National Match tests, the rifle itself is no longer used in ammunition test. In its place there are now used special heavy testing barrels.)

In prescribing the test at 300 yards, there was no consideration whatever given to the argument that a rifle is not fired at long ranges, either in battle or in practice. The author's statement that it is impossible to measure the accuracy of the gun or projectile satisfactorily at short ranges is not at all in accord with the views of the Board which selects National Match and International Match ammunition. International Match ammunition is tested at a range of 300 meters, while National Match ammunition is tested at a range of 600 and 1,000 yards.

Although the machine gun is frequently fired at long ranges, the accuracy test prescribed for the machine gun reads as follows:

> "Machine gun barrels and automatic rifles which, in firing at a range of 1,000 inches on landscape targets or miniature targets, show upon an examination of the characteristics of the bullet print on the paper that the print is oval shaped, instead of cylindrical, so that the maximum diameter of the oval is approximately twice the caliber of the bullet (2x30) should be considered as unserviceable and the proper action taken for replacement.
>
> "No allowance for ammunition is authorized for these tests, on account of the much greater relative cost of the ammunition, as compared with the barrels. All of the data necessary for the accuracy tests can be obtained during the current firing of an organization in instruction and record practice."

This test has been proven practicable time and again, and for Line troops is the only one that can be used. The expense of the ammunition involved is such a large factor that no allowance can be made for an accuracy test. For example, the original cost of a machine gun barrel which is being tested before being thrown away costs approximately $5.00 as compared to an original cost of war time ammunition of approximately $50 per thousand rounds. The cost of a new barrel would, therefore, pay for about 100 rounds, and the value of the ammunition required to offset the probable value of an old machine gun barrel can only be conjectured.

Erosion tests at Aberdeen for the machine gun are conducted at a range of 1,000 inches, even though there are facilities at that place for firing at the longest ranges. The reason for this is that, while the decrease in velocity, due to erosion, is not a serious factor, there reaches a point in the firing of automatic weapons where the bullet, on account of its lead core, becomes greatly deformed by the escape of gas past the bullet, due to an increase in the bore of the barrel from erosion and temporary heat expansion. This phenomenon occurs suddenly and immediately results in bullets tipping and keyholing at the very shortest ranges. This has been proven by firing through paper screens at 1,000 inches onto a water area of 2,000 yards, and plotting the dispersion at both places. The screen, which is very convenient to use and permits of a rate of fire of 200 rounds a minute being maintained, allows very convenient measurements to be made, and does not require the large personnel which is necessary for the long range firing.

Absurd as it may seem, it is possible to take a machine gun with a worn out barrel which throws keyholes at 1,000 inches when firing automatic fire, with the gun warmed up as under service conditions, and fire single shots with the barrel cold and get results in dispersion at the very longest ranges, which compare favorably with a new barrel.

The machine gun test cannot very well be applied to the rifle because the rifle does not involve automatic firing. On the other hand, the rifle test cannot be applied to the machine gun because of the characteristics of the machine gun. It is not in any sense of the word an accurate weapon and the mean radii at a given range may increase 100 per cent or 200 per cent and then decrease 50 per cent below the original measurement, due to certain inherent variations in the gun itself. For example, the barrel is what is known as a floating barrel; i. e., the barrel moves to and fro during the automatic action. The fit of the asbestos packing at the muzzle end, the fit of the muzzle gland itself, the amount of headspace, any change in the headspace, and a dozen other factors all affect the accuracy.

In conclusion, it may be added that in the case of the accuracy tests prescribed for Line use, the endeavor has been to allow the determination of a very considerable decrease in accuracy. Generally speaking, in so far as the rifle is concerned, a rifleman can qualify as long as he maintains an average dispersion on the target which is no greater than the four ring. This allowance is so great that an expert rifleman firing a rifle from a muzzle rest for three consecutive targets of ten shots each could not possibly exceed it unless the rifle is seriously inaccurate. However, if the test were prescribed for 1,000 yards, assuming that a range of that length is available, the same rifleman who was able to make very accurate groups at 300 yards is often unable to stay on the target at 1,000 yards, due to the difficulty of firing at such a long range from the effect of changing light and wind conditions. If the test were fired at 1,000 yards, it would be impossible to tell whether the rifle were at fault or the firer.

The original erosion firings upon which the accuracy tests are based are described in the issue of ARMY ORDNANCE for Nov.-Dec. 1921 under the article, "Long Range Small Arms Firing, Part V, Effect of Barrel Erosion on Machine Gun Dispersion," by the present writer. The latest available information which has been published on the method of firing the erosion test for the rifle and the machine gun at Aberdeen Proving Ground is contained in the ARMY ORDNANCE issues of May-June and July-August 1923 under the heading, "Testing Small Arms and Ammunition" by the present writer.

G. P. WILHELM,
Major, Ordnance Dept.

Development of Tripods

SPECIFICATIONS have been prepared for the development of tripods, both for ground and antiaircraft use. The development of the ground tripods consists of three

principal types. The first type is to be a simple and light tripod which can be easily transported and can be set up with the least delay. No mechanical traverse or mechanical elevating mechanism is required. This tripod shall be adapted to fire either against land targets or antiaircraft targets in case an emergency arises.

The second type of ground tripod is to be of medium weight with micrometric elevating mechanism and with the traversing dial to be provided with a support from the rear of the gun to the tripod proper. This tripod must also fire against aerial targets as well as ground targets.

The third type of tripod is to be of such weight as is necessary to gain a rigid mount and is to be provided with a mechanical micrometric elevating mechanism and mechanical traversing element. This tripod is required to fire against aerial targets with equal facility of that of firing against land targets.

The providing of a suitable mechanical traversing mechanism with a maximum error to be less than the unit reading of traversing dial, namely, 1 mil, presents a very difficult problem when the weight of the tripod, packing ability, durability and cost of manufacture are considered. To increase the diameter of the traversing element makes the tripod cumbersome for packing and handling, and to mount the traversing element onto the tripod in addition to the rear support of the gun, limits the traversing of the gun.

The designs being studied include antiaircraft elements, which are a part of the tripod proper, to avoid the necessity of carrying separate adapters which are cumbersome and seldom available when required, and the mounting of the machine gun on the center of gravity of recoiling parts with a view of making the mounts more stable.

The specifications which have been prepared for a suitable antiaircraft mount for caliber .50 and caliber .30 antiaircraft machine guns, specify that the gun shall be so mounted that the directing of the gun shall be such as to give free movement in order that the gun may follow target direct as the gunner would in shooting game in flight. This means no off-set can be made from the supporting stand to gain the higher elevation required, unless an additional movement is provided for free turning of the gun in the plane containing the offset.

Designs are being developed to incorporate these desirable features and to automatically give free movement to the gun without the necessity of mechanical or manual manipulation of the elements of the mount.

The problem of anti-aircraft sights also requires the mount to be designed so as to allow the gun to move only in a vertical plane or series of planes through the axis and bore.

S. S. GREEN.

Erosion Test of National Match Types of Ammunition

THE reports from the National Matches for 1924 acredit National Match ammunition for this year as being the most accurate and most satisfactory of any National Match type of ammunition so far produced. However, there was general criticism of the length of the accuracy life of the rifle when using National Match ammunition. Therefore, in order to determine whether the complaints of the riflemen were justified or not, the Ordnance Department conducted an erosion test at Aberdeen Proving Ground using four types of National Match ammunition.

The 1924 National Match ammunition was loaded with HiVel powder, which is a product of the Hercules Powder Company, and is a nitro-glycerin or double base powder. This is the same type of powder which has been used in recent years for National and International Match types of ammunition, and it has consistently given the greatest accuracy at the longer ranges. It has a serious disadvantage in that it is a very hot burning powder and considerable erosion results. For this reason it can not be considered in any way a satisfactory type of powder for service ammunition.

From the criticisms at Camp Perry regarding erosion of rifle barrels, it was not clear whether this erosion was due to the use of HiVel powder or some change in the steel used in the barrels of the rifles, or whether to the change in the National Match bullet from the one used in 1923.

Since there has been no change in the manufacture of HiVel powder from previous years, and since there has been no change in the rifles it was thought possible that if there was an increased erosion it might have been due to the change in the bullet. The bullet used in the 1923 Matches was a boat-tail bullet with a 6° tapered base, while in the 1924 Matches the bullet had a 9° tapered base. The length of taper being longer than the previous type of bullet it was considered that possibly this change in the base of the bullet may have allowed the erosive gases to operate more quickly on that portion of the barrel immediately in front of the chamber.

From a study of the various factors it did not look as if there should have been any more erosion during the 1924 Matches than in the previous Matches, for among the changes in the bullet a longer bearing was incorporated in the 1924 bullet than was used in the 1923 bullet, and this usually improves factors with regard to gas cutting.

In order to make a reliable erosion test which could be expeditiously completed it would be necessary to use the heavy Mann type of testing barrel and the Mann V Rest. This is the type of rest which is used in testing National Match ammunition as the use of rifles for ammunition testing has been discredited on account of the tendency of the various unknown factors, such as the effect of the rifle stock on the barrel and the effect of the machine rest on both the stock and the barrel, to produce unreliable results.

The test program involved the use of two types of bullets and two types of powder; that is, one lot of ammunition had the 1923 6° type of bullet loaded with HiVel powder, while another lot of ammunition had the same bullet loaded with the DuPont progressive burning type of military powder; by military powder is meant one considered satisfactory for use in the military service. Another lot of ammunition contained the 1924 9° bullet loaded with HiVel powder, while the fourth lot contained the same bullet with DuPont powder.

In order to get a check on the results, two heavy barrels were assigned to each lot of ammunition. It was intended if there was a discrepancy in the results that a third barrel would be fired with each lot of ammunition. This, however, was found to be unnecessary. In other words, there were four different heavy barrels which were tested with HiVel powder and four barrels tested with DuPont powder. Likewise, there were four barrels which used the 9° bullet and four barrels which used the 6° bullet.

The test was conducted at a range of 600 yards and all four types of ammunition were fired simultaneously, the

rate of fire being one shot every ten seconds. At the end of every five targets of ten shots each, the barrels were cleaned and cooled and the test resumed. The firing was continued for 250 targets of ten shots each. All targets were measured for the extreme vertical.

A study of the target measurements shows that there was little or no difference in the erosion in barrels which used both the 6° and 9° types of bullets with the same powder. There can be but little question that the change in the design of bullet has had no effect insofar as the accuracy life of the barrel is concerned.

In order to draw conclusions from the test it is found necessary to take the average results obtained with a series of 50 targets. That is, take the average results obtained with each type of powder and bullet for two barrels and compare the average extreme verticals of five sets of 50 targets each. Otherwise, the difference in the measurements are so small compared with the variations in individual targets, and even in the series of 10 targets, that it is difficult to obtain the comparison.

The following table give the target average measurements for five series of 50 targets each:

TABLE SHOWING COMPARISON OF EFFECT ON ACCURACY FROM FIRING 2500 ROUNDS WITH FOUR TYPES OF NATIONAL MATCH AMMUNITION. RANGE 600 YDS.

TARGETS	9° B. T. Bullet HiVel Powder	6° B. T. Bullet HiVel Powder	9° B. T. Bullet DuPont Powder	6° B. T. Bullet DuPont Powder
	Average Extreme Verticals			
1 to 50	8.478	8.600	8.313	7.789
51 to 100	8.753	8.497	8.588	8.022
101 to 150	8.266	7.872	8.822	8.621
151 to 200	9.604	9.650	9.612	8.898
201 to 250	10.510	11.671	9.457	8.976

A study of this table will show for the HiVel powder and both bullets that the greatest accuracy was obtained with the third series of 50 targets. In other words, the best targets were obtained while firing the 500 shots between 1,000 and 1,500. The smallest average extreme verticals for 50 targets with barrels using 9° bullet and HiVel powder is 8.226″. The greatest average extreme verticals was obtained with a series of shots from 2,000 to 2,500, this measurement being 10.510″ extreme vertical. The difference between the smallest average of 50 targets and the greatest average of 50 targets is 2.244″ extreme vertical. In other words, the firing of this test shows that the greatest increase in the extreme verticals was 2¼″ approximately.

In the case of the 6° HiVel barrels the smallest average extreme vertical for 50 targets was obtained in the third series, this measurement being 7.872″ extreme vertical. The greatest average extreme vertical was obtained in the fifth series which was 11.671″ extreme vertical. The difference between the two is 3.799″ or an increase of 3¾″ approximately.

These figures tend to indicate that the 9° bullet gave less erosion than the 6° bullet. The difference between the two, however, is undoubtedly negligible and in a considerable amount of firing with a greater number of barrels would probably decrease.

The 9° bullet with the DuPont type of powder had the smallest extreme vertical in the first series of 50 targets. This measurement is 8.313″. The greatest extreme vertical, however, was not in the last series as was the case with the HiVel powder, but was in the fourth series. This measurement is 9.612″, or a difference of 1.299″, which is approximately 1⅓″. This increase is so small that it can be considered as no loss of accuracy due to erosion.

For the set of barrels using the 6° bullet with DuPont powder the smallest average extreme vertical for 50 targets is in the first series and measures 7.789″. For these barrels there is a progressive increase in the size of the average extreme verticals for each series, the largest group being the last series which measures 8.976″. The difference between the first group and the last is 1.187″, or approximately 1⅕″. This figure is again negligible and shows for the DuPont powder in both the 6° and 9° bullet, that there is no decrease in accuracy.

An inspection of the barrels, themselves, shows that when using HiVel powder after firing 300 or 400 rounds, that portion of the barrel immediately in front of the chamber begins to blacken and shows signs of burning. This blackened area increases as the test proceeds but it is quite evident from the figures that it had no adverse effect upon the accuracy, at least for 1,500 rounds, and very little for the 2,500 rounds. In the case of the DuPont powder there was little or no evidence of the effect of the powder gases.

The test as outlined is subject to one criticism, and that is that the conditions of firing the test are not comparable to the firing of the rifles at the Matches. It has been contended that the use of the heavy barrels with their ability to stand continued firing with less heat effect than the light barrel in the rifle does not prove that the use of HiVel powder in the rifle would not result in rapid erosion.

This question is being investigated but it is not considered that the results in the long run will be much different. The Mann barrels were fired at a rate of fire of one shot for every ten seconds for fifty shots, as compared with the highest rate of fire with the service rifle of ten shots in one minute. Also this rate with the rifle is not continued for fifty shots but only for ten shots. It is believed the continued firing of fifty shots at a high rate of fire with heavy barrels would tend to overheat the barrels more than the firing of ten shots with the rifle barrel.

The weather conditions under which the test was fired were quite ideal and since all Mann barrels are specially selected for uniformity, the results, as could be expected, were remarkably uniform. The ammunition, itself, was machine loaded and, considering that no special attempt was made to achieve great accuracy, the results are considered remarkable. While it is impossible to make a fair comparison of the several types of ammunition due to the fact that there is some difference in the accuracy of the barrels themselves, yet the following table shows that the accuracy of all types was remarkably close.

TABLE SHOWING COMPARISON OF ACCURACY FOR FOUR TYPES OF NATIONAL MATCH AMMUNITION. RANGE 600 YDS.

TARGETS	9° B. T. Bullet HiVel Powder	6° B. T. Bullet HiVel Powder	9° B. T. Bullet DuPont Powder	6° B. T. Bullet DuPont Powder
	Average Extreme Verticals			
1 to 150	8.499	8.323	8.5743	8.144
1 to 250	9.1222	9.258	8.9584	8.4612

The average extreme verticals of the 9° HiVel powder in two barrels for 1,500 shots, each, was approximately 8½″, while for the full 2,500 rounds it was approximately 9⅛″. For the 6° HiVel powder these figures are approximately 8⅓″ and 9¼″, respectively.

In the case of the 9° DuPont powder the first 1,500

rounds gave an extreme vertical of 8½" approximately, and for the full 2,500 rounds a trifle under 9". Likewise, the 6° DuPont powder gave an average of 8 1-7" for the first 1,500 rounds and less than 8½" for the full 2,500 rounds.

The measurement of the mean radius was not taken on account of lack of time, but for the sake of comparison the extreme vertical figures can be used, bearing in mind that the mean radius usually runs about one-third of the extreme vertical.

It was finally concluded as a result of this test that for Match purposes the use of a nitro-glycerin type of powder, such as HiVel, is satisfactory from the standpoint of erosion.

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PICATINNY ARSENAL

Deterioration of Cartridge Cloth

ORDNANCE Department specifications covering the cloth used in the manufacture of cartridge bags for cannon, prescribe that pure silk, wool or mohair must be used; in case of cartridge igniter cloth, pure silk only is permitted. The advantage in using silk lies in the fact that it has great tensile strength, burns rapidly and leaves very little residue in the gun. It has been found that the silk fiber has tensile strength almost equal to that of iron wire of equal diameter.

Since raw silk is not produced in the United States to any great extent, it is necessary to import the yarn; this importation is principally from China and Japan. During the World War, it was only with considerable difficulty and delay, that the yarn was obtained in sufficient amount to meet the unusual demand. However, some time prior to the close of the War, the textile mills were weaving cartridge cloth on a large scale and production was rapidly increasing. When all contracts were completed shortly after the War, the Ordnance Department had a large supply of each grade of cloth left on hand. Mindful of the uncertainty and delay which attended the effort to procure the raw silk from abroad, it was wisely decided to retain a supply of silk as a war reserve.

About five years after the close of the War, the question was raised as to whether the silk storage was not deteriorating to such an extent that it would soon become unserviceable; if such was true, salvage of the cloth was contemplated. Picatinny Arsenal was asked to assist in answering the question by conducting a thorough investigation of the condition of the cloth stored at various places.

Since any deterioration of the silk would be attended by a reduction in the tensile strength of the cloth, numerous samples of each grade of cloth, representing a variety of conditions of storage, were obtained and subjected to the standard test for tensile strength. These tests showed that some deterioration had occurred, many samples of the heavier grades failing to meet the specification for tensile strength. The reduction in tensile strength since the time of the acceptance tests was, however, not excessive and it was concluded that the cloth was in general satisfactory for use. When the specifications for the cloth of the various grades were drawn originally, the requirements for tensile strength were placed sufficiently high to allow for average deterioration and hence the slight reduction in the tensile strength of the samples tested, was not considered of any great importance.

In addition to tensile strength determinations, a chemical and microscopic examination of the samples was made to find whether the deterioration which caused a lowering of tensile strength might also have produced other undesirable conditions, such as acidity, weak spots in the cloth due to local mildew or dry rot, etc. The investigation failed to reveal any such conditions.

Since it appeared advisable from the results of the investigation, to retain the cloth in storage, attention was next given to determining the most satisfactory conditions of storage, i. e., conditions which would minimize further deterioration if not wholly prevent it. In order to accomplish this it was of course desirable to know the general cause of the deterioration of silk. Recourse was made to the literature on the subject and to consultation with some of the leading textile experts of the country but very little light was thrown on the question as to why and how silk loses is strength. Very valuable practical information was obtained, however, which pointed out the conditions found most suitable as a result of experience for the storage of silk. The life of the cloth can be greatly extended if conditions which give rise to mildew or dry rot are eliminated. Thus the silk should be stored in well ventilated magazines where a free circulation of cool air is possble. The silk should not be packed in boxes but rather in bales on open wood shelves. The bales should not be piled one on top of another as this prevents exposure to fresh air and also causes an excessive weight on the cloth at the bottom of the tiers. It is desirable to maintain a fairly constant temperature of 50°-60° F. and a humidity of about 50 per cent in the magazines, where such conditioning is practicable. Such precautions will reduce the rate of the deterioration considerably but experience has shown that silk even if 100 per cent pure will gradually lose its tensile strength in spite of such precautions.

This tendency to gradually suffer a loss of tensile strength is a property common to all animal fibers such as wool, silk, mohair, etc., and it has been generally assumed that such deterioration is an inherent property of all substances which constitute a portion of the body of living organisms. In the same way that the body of any animal decomposes after the life process has ceased, those portions which are removed during the life of the animal begin to deteriorate as soon as they are separated from the life source.

It would nevertheless be desirable to know the nature of the chemical changes which occur during this deterioration for such knowledge might enable logical steps to be taken toward retarding the action. Very little, other than as indicated above, has been accomplished in this direction because of the chemical complexity and close similarity of the compounds which make up the fibers. A discussion of the nature and properties of the silk fiber will indicate the difficulty in such a study.

Silk fiber is a thread spun by the silkworm which at the time of spinning also weaves the thread around its body, layer on layer until it is completely enclosed within the finished cocoon or shell. After thus protecting itself from outer influences the worm undergoes a transformation in which it loses its original form and passes into an inert pupa or chrysalis. This chrysalis then gradually

develops into a butterfly which cuts its way through the cocoon to gain its freedom. Since the breaking of the cocoon destroys the continuity of the fiber, it is the practice in the cultivation of silk, to prevent the development of the crysalis into a butterfly. The chrysalis is killed by heating the cocoon in an oven for several hours at a temperature of about 70°C, or by treating the cocoons with live steam. The cocoons are then unreeled and the fibers twisted together to form threads suitable for weaving. This product is the raw silk of commerce. The short tangled fibers from the exterior of the cocoon are used for making spun silk which is a lower grade than the raw silk.

These silk fibers are composed of two principal constituents; the one, fibroin, forms the interior and greater part of the fiber; the other, known as sericin or silk glue, forms the outer coating. An analysis of these constituents has shown them to consist of carbon, hydrogen, oxygen and nitrogen, the proportion of each element in the fibroin being different from that in the sericin. The molecular structure and size of these compounds cannot be determined and their chemical nature can only be ascertained from a study of their reactions. Such a study has led to the belief that sericin is an alteration product of fibroin, the conversion of the latter into sericin being brought about by the assimilation of water and oxygen. This has not been proved, however, and it has been indicated by the work of certain investigators that both fibroin and sericin are not pure chemical compounds but rather are mixtures of numerous complex compounds some of which are present only in minute amounts. The difficulties connected with the isolation and identification of such compounds are so great that it seems the present state of our chemical knowledge is not sufficiently advanced to overcome them. It is doubtful whether the true cause for the deterioration of silk can be determined unless chemistry is able to get closer to the life process of the silk worm and better understand the nature of the secretions which give rise to the silk fiber. It is not wholly improbable, however, that the deterioration of the fiber is more of a physical change than a chemical one. Thus it may be that the structural arrangement of the fiber as a whole is altered by the variations in temperature and humidity to which the finished silk cloth is exposed during its manufacture and use. A thorough study of this point could only be made by starting with the raw silk as soon as it comes from the cocoon, subjecting it to various conditions, measuring the changes that occur as a result of the treatment. It is rather surprising that such has not been done. Owing to the nature of the silk trade, efforts have been extended toward obtaining the highest luster, the most beautiful and varying effects from dyeing, etc., but for reasons which may be surmised no great effort has been made to determine the causes of deterioration and thereby make possible logical action toward increasing the life of finished silk fabrics.

G. C. Hale.

BUREAU OF MINES

The Specific Heat of Smokeless Powder*

Dr. C. G. Storm, representing the Ordnance Department, U. S. Army, on the Committee on Explosives Investigations of the National Research Council, having expressed the opinion that it would be of interest to know the effects of the total volatile contents (moisture and residual solvent) on the specific heat of nitrocellulose smokeless powder, a series of determinations were made on samples furnished by him, following the same procedure as in the determination of the "Specific Heats of Trinitrotoluene, Tetryl, Picric Acid and Their Complexes."**

The samples were all of the usual form of cylindrical grain with seven longitudinal perforations, the web thickness of the grains and, consequently, their content of total volatiles, varying over a wide range, as shown in the table below.

The mean specific heat was determined from zero centigrade, room temperature (22-24°C.), and the boiling point of water, (99.3°C.), to −182.8°C. by dropping small pieces of smokeless powder at these temperatures into liquid oxygen and measuring the amount of oxygen evolved by the heat liberated. Pure lead, whose specific heat had been accurately determined, was used as a standard and the mean specific heat of the smokeless powder was obtained by comparison. The maximum variation in any series of tests was 0.005 cal. At least three determinations were made with each powder at each temperature and the results given in the following table are the averages of these results.

Total volatile	Mean specific heat—182.8 to 0°C.	22-24° C.	99.3° C.	Calculated mean specific heat, 0°-100° C.
2.72	0.175 cal.	0.186 cal.	0.202 cal.	0.252 cal.
3.53	0.175	0.188	0.207	0.266
4.08	0.174	0.186	0.204	0.259
4.62	0.178	0.185	0.206	0.257
4.81	0.181	0.186	0.209	0.265
5.12	0.179	0.182	0.208	0.261
6.46	0.180	0.185	0.210	0.265
6.60	0.183	0.189	0.210	0.260
7.38	0.182	0.186	0.210	0.262

Conclusion. The method is not sufficiently accurate to show the exact effect of the volatile content. The average mean specific heat for smokeless powder from 0° to 100° C. is 0.261 cal. which is accurate to ±0.005 cal. by this method.

C. A. Taylor and W. H. Rinkenbach.

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Book Reviews

Strength and Structure of Steel and Other Metals. By W. E. Dalby. New York: Longmans, Green and Co. 1923. 176 pages. $6.00.

PROFESSOR Dalby's book is built up around the load extension diagram or the stress strain curve of various materials. The latter portion of his book contains the results of the author's own work, whereas the earlier chapters deal primarily with those common facts found in many books on the testing of materials.

Professor Dalby has done a remarkable piece of work in the development of his optical stress strain curve recorder. Those who have followed this work will be very glad to see his results at least partly summarized in book form. The complete stress strain curve and the hysteresis loop have been largely disregarded by most investigators. This timely publication of Professor Dalby's work should serve to focus the attention of many who are engaged upon the testing of materials to the new instrument which the author's ingenuity has made available.

Industrial Alcohol. By John Geddes McIntosh. Second and enlarged edition. London: Scott, Greenwood and Son. 400 pages. Illustrated. $5.00.

THE first edition of this book was published in 1907, and the many references to the literature of more recent date in the present edition indicate that it has been considerably revised and enlarged. The book comprises 14 chapters, devoted to the following subjects: (1) alcohol and its properties, (2) continuous fermentation and sterilization, (3) to (9) manufacture of industrial alcohol from beets, grain, potatoes, surplus stocks of wine, sugar cane and molasses, miscellaneous sources, waste wood and sulphite cellulose liquor, (10) production of alcohol by synthetic processes, (11) plant for distillation and rectification, (12) manufacture and uses of alcohol derivatives, (13) statistics and uses in manufactures, (14) use for lighting, heating and motive power.

A brief description is given of the process employed in the plant at Hattiesburg, Miss., for producing alcohol from wood waste. Discussion of the production of alcohol from sulphite cellulose waste liquors is confined to the industry in Sweden, although it is noted that "considerable quantities are now made in the United States from this source." In the chapter on alcohol derivatives, industrial methods are entirely neglected in the case of such materials as ethyl ether, chloroform, iodoform, etc.

Data given in the chapter on statistics is greatly out of date as regards the United States, the information being quoted from U. S. Internal Revenue Circular of 1907. The discussions of the uses of alcohol for lighting, heating and motor fuel are of special interest. The book is well written and sufficiently comprehensive to be of interest to the layman as well as the chemist and manufacturer. Unfortunately the author has not devoted a chapter to a discussion of the effects of the prohibition laws in the United States on the industrial use of alcohol.

Light and Work. By M. Luckiesh. New York: D. Van Nostrand Company. 15 chapters. 292 pages. Illustrated. $4.00.

LIGHT has always been an important factor in the environment of living things. Without light, life on earth would be impossible. But for practical purposes, natural light is absent half of the time. Man in his evolution away from primative savagery has gradually created for himself an artificial world in which the daily span of natural light is no longer sufficient. Artificial lighting has been the result. The studies in this field have been enormous and the ideal is not far short of realization at the present time under the pressure of scientific research.

The able director of the lighting research laboratory of the General Electric Company has added to his other works on lighting problems, color and visual phenomena, this excellent treatise on the relation of light to working conditions. A brief account of the influence of light as an environmental factor in the evolution of man is followed by chapters on daylight, outdoors and indoors. Artificial light is then considered in its modern state and is followed by a discussion of fundamental visual functions, the time element of vision, the influence of intensity of illumination on human production, and the best range of illumination intensity for effective work. The author then proceeds to the consideration of the economic value of adequate lighting and shows the savings which can be made by proper illumination in factories. Some striking facts are introduced in the chapter on "Lighting and Production" supporting the thesis that proper lighting increases production, reduces spoilage, and decreases the accident rate. It is noteworthy that the author estimates an increase of 10 per cent in production under better lighting conditions and that a general improvement of lighting in American factories would, without additional cost, increase the annual value of the finished products from these factories in excess of 2.5 billion dollars.

The book is well written and copiously illustrated. It should serve as an excellent reference work for the factory executive and the lighting engineer and for all others interested in the efficient employment of human beings in manufacturing establishments.

Annotated Forms of Agreement. By Saul Gordon. New York: Prentice-Hall, Inc. $5.00.

THIS book will interest the executive and engineer not only because of the important role it plays in the everyday affairs of business but also because it makes accessible topics that were thought to exist only in the inner temple of the barrister's ponderous intellect.

It is one of those constructive pieces of work with a definite aim and an important purpose. Mr. Gordon, the author, a talented member of the New York Bar, has

prepared a compilation of forms of agreement covering a great many of the contractual relations of modern life. Needless to say the presentation is made with all the skill and clarity of the precise student and the painstaking author. Many of the forms set out are adjudicated precedents and in this respect the annotated feature is excellent. Others, while without the sanction of judicial determination, are the products of counsel who have the unalloyed confidence of bench and bar. The forms cited are therefore dependable and "fool-proof."

The thoroughness with which the author has performed his work may be understood when, for instance, the one topic "Buyer and Seller" is discussed. Here we find the general subject divided into seven sections. The first, "Agreements relating to sale of merchandise," cites eight forms of agreements from one to sell carbolic crystals to a contract to sell soda ash in monthly installments whereunder each shipment is to constitute a separate sale. Section 2 refers to "agreements to purchase all merchandise required in buyer's business." Here are given typical forms of agreement of which one "to sell all calcium carbide which buyer may require in its business, during the year" is a sample. Section 3 gives "agreements to purchase seller's entire output." Section 4 contains agreements to sell merchandise whereunder buyer is given exclusive sales territory. The next section is given over to agreements relating to sales of business. Section 6 covers agreements relating to purchase of stock, which in turn is subdivided into (a) agreements made before incorporation, and (b) those made after incorporation. The final section is a miscellany which covers practically all that the preceding sections have not explained. And this is but one of 24 similar chapters of an excellently bound, thin paper, 904-page book.

With Professor Wormser of Fordham, who writes the introduction, we, too, can say: "There is a distinct and genuine need for such a book." The many executives who are members of the Army Ordnance Association would do well to include this book among the select half-dozen that are usually within arm's reach.

The Industrial Worker, 1840-60. The Reaction of American Industrial Society to the Advance of the Industrial Revolution. By Norman Ware. Boston: Houghton-Mifflin Company. 249 pages. $2.50.

THIS volume covers a very interesting period in American history during which the necessary readjustment of the economic life of the nation on account of the Industrial Revolution proceeded at a rapid pace. The misery which rapid changes in the habits of industry seem to make inevitable are described with ample reference to contemporary sources of information.

Baxton Bragg, General of the Confederacy. By Don C. Seitz, Columbia, S. C. The State Company. 1924. 544 pages. $5.00.

AMONG the generals of the Confederate Army the name of General Bragg will always remain an outstanding figure. As a West Point cadet he showed exceptional scholarship and graduated high up in his class. During the Mexican War he proved himself a capable officer and, though retired and living on his Louisiana plantation, it was not surprising that on the outbreak of the Civil War he was immediately given a high command in the Confederate Army.

Fortunately this volume has not been written either to defend or vindicate but rather to put in concrete form the events of his military life so that all may judge as they see fit. The style is unusually entertaining. The character of the man is not pictured in long descriptions but rather in his deeds and actions. Throughout there is that touch of human interest which holds the reader. Many letters written by General Bragg to his wife are printed which show not only literary ability on the part of the author but also a warmth and kindness seldom associated with his name.

As the biographer himself has said, it is not a grateful task to write a biography of a much hated man whose military efforts led to defeat. Nevertheless it is a biography of a most interesting character, a man who created strong dislikes among those in sympathy with him as well as those opposed. We are given a glimpse into the inner man and are left with the conviction that, though his views may have differed from ours, he believed in himself and was willing to give all for that principle for which he fought. There is little doubt that this book has added prestige to the name of Bragg in the annals of war.

A Simplified Grammar of the Japanese Language (Modern Written Style). By Basil Hall Chamberlain. Revised edition by Major James Garfield McIlroy, U. S. A. Chicago: The University of Chicago Press. 1924. 144 pages. $2.00.

MAJOR McIlroy of the Military Intelligence Division of the General Staff has revised the standard text of Chamberlain—long out of print—and brings this grammatical treatise on the Japanese written language down to the present day. Therefore, all that made the original text the standard for the use of English speaking people is contained in the present work plus some interesting and important addenda notably the use of the general rule for the quick separation of the verb into its stem and its inflected parts. In this connection there is given an alphabetically arranged list of verb and adjective inflections which should transform the grammar into a quasi-dictionary and thus enhance its use.

The value of this work lies in the great probable assistance it can render the student of the Japanese written language. It is neatly and thoroughly gotten up, for which revisor and publishers are to be congratulated. To the soldier who is interested and to the business man whose activities might require a knowledge of the written Japanese tongue this revised work should be of considerable help. The text treatment and arrangement is well done.

Blockade and Sea Power. By Maurice Parmelee, Ph. D. New York: Thomas Y. Crowell Company, 1924. 449 pages. $3.00

COMES now a civilian, Maurice Parmelee by name, Ph. D. by attainment, invading the sacred province of the incomparable Mahan, presenting us with a treatise on "Blockade and Sea Power." The author's previous researches had embraced such fields as "Criminology," "Poverty and Social Progress," "Personality and Conduct," and "The Science of Human Behavior." A closer examination of the volume now being reviewed discloses that its contents are not indicated by its title, but rather by its sub-title, which reads "The Blockade, 1914-1919, and its Significance for a World State." This could be abbreviated into "The Recent Blockade and Future World State," which is what the volume is all about.

The first part of this work is further entitled, "History of the Blockade, 1914-1919" and is a real contri-

bution to the subject. Although the author was a delegate on the Allied Blockade Committee and Chairman of the Allied Rationing and Statistical Committee some time after our joining forces with the Allies, his recital of events and circumstances, as he understood them, is apparently as impartial and unprejudiced as can be. His rather brief contact with the later workings of the blockade, enabled him to gather, in considerable detail, data regarding the administrative organizations erected in England (and later in the principal Allied and Associated Countries), for the purpose of giving effect to the policy of cutting off the Central Powers completely. There are also descriptions of the organizations which came into being in the neighboring neutral states for the purpose of treating with the blockaders.

The second part of the volume is devoted to developing the theme of the most desirable World State and pointing out the flaws in the League of Nations as at present constituted. Sea power is mentioned by name ocasionally, but the discussions are rather sketchy and are used only to develop the main theme. For instance, he says "Probably the earliest attempt to appropriate marine areas was the claim to territorial waters within the range of weapons from the shore. Thus one of the earliest of such claims was to the water within the range of stones flung from the land." The source of this information is not divulged. Throughout this part, his viewpoint is colored by his earlier researches as a criminologist and mental student, as one of his introductory sentences shows: "Furthermore, the sentiment of patriotism is greatly exaggerated in time of war and renders a people almost entirely incapable of appreciating the mental attitude of the enemy, to whom they are induced, by the powerful emotions of fear and of hatred exacerbated by wartime hyperesthesia, to attribute the most infamous motives." As he warms up to his subject, he says, "There is a sort of poetic justice in blockade because it distributes in a measure the burden of war over the whole of a belligerent nation. There is some justification for asserting that every belligerent nation should be blockaded in order that the women and children and noncombatant men may be forced to share to at least a small degree the suffering and sacrifice which inevitably fall upon the combatants." Yea! One must go far in the works of purely military and naval writers to find half as blood thirsty and vengeful a justification for the blockade or any other act of war! Yet the author looks askance at the profession of arms, and would abolish the Army and Navy as such.

His sympathetic soul revolts at the contemplation of the Brest-Litovsk Treaty for including annexations without self determination of the peoples concerned. An appendix quotes at length from a German writer who ascribed to Count Czernin the revelation that slices were taken from Russia at the behest of the military. Had the author troubled to familiarize himself with Czernin's works, he would have learned that it was Trotsky himself who objected to the farce of a plebescite and who desired the wording of the treaty to show grab methods in order to assume an attitude of helplessness before his fellow Russians at home.

The author has coined a new word—"navalistic," referring chiefly to writers. The genesis of the coinage is not far to seek, for it transpires that Mr. Parmelee is an adept in the use of the word "capitalistic." Our capitalistic world should be abolished, thinks he, for "it is not likely that a genuine world state can come into existence under a capitalistic system." But to return to navalistic. He says, in scoring the post-war naval program and ambitions of the United States, "Unfortunately the ground for this development had been partially prepared even before the war by a group of navalistic writers, the most notorious of whom was the late American Admiral Mahan."

He accuses Mahan of "misusing historical facts in support of his navalistic propaganda," and ridicules Mahan's assertion that "The German Empire, which owes its existence to its army, has, thanks also to its army, known forty years of unbroken peace." He forgets, or did not take the trouble to learn, that, as one writer has summarized it, Mahan "In the year of 1910, predicted that the attack would come from Germany, that Italy would leave the Triple Alliance, that submarines would not subjugate battleships, that the Zeppelins would be found to have been greatly overrated, that sea power would be the deciding factor and that the German navy would surrender to the British Fleet." If the Dean of writers on sea power could so interpret the lessons of history as to predict this series of events from four to eight years before it happened, the puerile fault-finding of amateurs cannot dim the luster of his genius.

Mr. Parmelee feels that the League of Nations, dominated by the victorious principal Allied Powers, with its provisions for coercing nations not members of the League, becomes a military alliance differing only very slightly from military alliances of the past and present. He apparently proves his point. The prerequisite for his World State is the abolition of absolute national sovereignty. Its form is democratic. There is complete national disarmament on land and sea and in the air, except a home police force. There are no discriminatory economic measures between any localities; capitalism and modern finance controling governments and causing war, are abolished. All colonies and sections having inferior peoples are administered by the World State under mandatories, to prevent exploitation.

Mahan is not with us to write "The Influence of Sea Power on the World War." In time some books will appear that will do justice to the subject. This volume is not one of them. It should be read, however, to see how the minds of some of our fellow citizens work, who would turn our national sovereignty over to strangers and abolish our Army and Navy.

The Messages and Papers of Woodrow Wilson. With Editorial Notes, an Introduction by Albert Shaw and an Analytical Index. 2 vols. New York: The Review of Reviews Corporation. 1924.

IN these volumes are collected the spoken and written messages of President Wilson, beginning with his first inaugural address, March 4, 1913, and concluding with his radio address delivered on the eve of Armistice Day, 1923, just three months before his death.

For those who lived through the "days that tried men's souls" the contexts—for some of us even the very words—are familiar. We know their full meaning; we comprehend their mighty import. They ring with all the idealism that we knew and which many of us revered.

The writings and addresses of our Presidents comprise, from the very first, a commentary on our Constitution, our national life and our national progress that matches—if it does not excel—the similar state documents of the world. Those which form the contribution of our late War President to an already priceless national collection

are by no means the least conspicuous either as to the diversified matters to which they relate, the consumate diction in which they are expressed, or the high sentiment with which they are inspired. Their ultimate value lies in their worth to generations to come.

As a stylist President Wilson must rank high among the rulers of history. In this respect it will be sufficient for the purposes of this review to recall at random quotations from some of his addresses that will, we venture to predict, vie with the immortal pronouncements of Washington, Jefferson and Lincoln as examples of clarity of thought, hegemony of purpose, and beauty of expression. True comparison is difficult even in such cases. Nor do we cite the following quotations by way of strict comparison. We take merely those writings which have already been singled out from this vast collection and quote three of pre-eminent strength of diction and beauty of expression.

The first is the address to the Senate on the essential terms of peace in Europe, delivered January 22, 1917, the peroration of which is:

> "I am proposing that all nations henceforth avoid entangling alliances which would draw them into competitions of power, catch them in a net of intrigue and selfish rivalry and disturb their own affairs with influences intruded from without. There is no entangling alliance in a concert of power. When all unite to act in the same sense and with the same purpose all act in the common interest and are free to live their own lives under a common protection.
>
> "I am proposing a government by the consent of the governed; that freedom of the seas which in international conference after conference representatives of the United States have urged with the eloquence of those who are the convinced disciples of liberty, and that moderation of armament which makes of armies and navies a power for order merely, not an instrument of aggression or of selfish violence.
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> "These are American principles, American policies. We could stand for no others. And they are also the principles of forward looking men and women everywhere of every modern nation, of every enlightened community. These are the principles of mankind and must prevail."

The closing lines of the memorable address to Congress advising that Germany's course be declared war against the United States will live as long as our traditions last:

> "It is a distressing and oppressive duty, Gentlemen of the Congress, which I have performed in thus addressing you. There are, it may be, many months of fiery trial and sacrifice ahead of us. It is a fearful thing to lead this great peaceful people into war, into the most terrible and disastrous of all wars, civilization itself seeming to be in the balance. But the the right is more precious than peace and we shall fight for the things which we have always carried nearest our hearts, for democracy, for the right of those who submit to authority to have a voice in their own governments, for the rights and liberties of small nations, for a universal dominion of right by such a concert of free peoples as shall bring peace and safety to all nations and make the world itself at last free. To such a task we can dedicate our lives and our fortunes, everything that we are and everything that we have, with the pride of those who know that the day has come when America is privileged to spend her blood and her might for the principles that gave her birth and happiness and the peace which she has treasured. God helping her, she can do no other."

For lofty conception and perfect prose we cite the exordium of President Wilson's Flag Day address, June 14, 1917:

> "We meet to celebrate Flag Day, because this flag which we honor and under which we serve is the emblem of our unity, our power, our thought and purpose as a nation. It has no other character than that which we give it from generation to generation. The choice is ours. It floats in majestic silence above the hosts that execute those choices, whether in peace or war. And yet, though silent, it speaks to us—speaks to us of the past, of the men and women who went before us and of the records they wrote upon it. We celebrate the day of its birth; and from its birth until now it has witnessed a great history, has floated on high the symbol of great events, of a great plan of life worked out by a great people. We are about to carry it into battle, to lift it where it will draw the fire of our enimies. We are about to bid thousands, hundreds of thousands, it may be millions, of our men, the young, the strong, the capable men of the nation, to go forth and die beneath it on fields of blood far away—for what? For some unaccustomed thing? For something for which it has never sought the fire before? American armies were never before sent across the seas. Why are they sent now? For some new purpose for which this great flag has never been carried before, or for some old, familiar, heroic purpose for which it has seen men die on every battlefield upon which Americans have borne arms since the Revolution?
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> "These are questions which must be answered. We are Americans. We in our turn serve America, and can serve her with no private purpose. We must use her flag as she has always used it. We are accountable at the bar of history and must plead in utter frankness what purpose it is we seek to serve. . . ."

Of these volumes, Mr. Shaw, who contributes a well-wrought introduction, says: "The material contained in these two volumes is concerned with Wilson's presidential career. His followers by the thousands were vainly hoping that his health and strength would return and that he might for a long time continue to exercise moral and intellectual influence upon the course of affairs, as Jefferson did in the years after his retirement from office. But Wilson's own life work had been performed, and he takes his historic place in the list of American political leaders. The precise position which he will occupy in the estimation of men yet unborn is likely to be determined even more by the record of his utterances than by the chronicle of his deeds: and this collection of the written and spoken messages and addresses of his eight years in the presidency will be found essential."

Keeping Up With Science. By Edwin E. Slosson. New York: Harcourt, Brace and Co. 1924. Illustrated. 355 pages.

IN 1921 the Science Service was founded in Washington for the purpose of disseminating scientific knowledge and achievements among laymen. It was believed the public needed better facilities to become acquainted with the results of modern science and that a mutual benefit would result through a wider understanding of scientific data. Edwin E. Slosson, under whose name this volume appears, is director of this service and has been highly

successful in carrying out this ideal through various channels including books, newspaper and magazine articles.

The idea of the author has been to present in clear and concise articles some startling facts in the scientific world. No claim to originality is made. Rather the author has endeavored to collect together in a handy volume miscellaneous articles and notes which may or may not have appeared elsewhere. These articles have, if it was deemed necessary, been rewritten so that all appear in popular style. In all, 347 subjects are treated, each from one paragraph to several pages in length. The following titles chosen at random illustrate the nature of the subjects: "Weather Fallacies," "How Arrow Heads are Made," "An Easy Einstein Problem," "The Tractor that Walks like a Horse," "A Mercury Engine," etc.

In general the articles are written in a fascinating manner which appeals to all classes of readers. The scientific man, while perhaps having a dim recollection of the thought expressed, is nevertheless not adverse to having this thought clarified and verified. Even to those caring little for science, the witty comment will have its appeal. Unconsciously there is created a greater desire for scientific knowledge.

The value of the book lies not in its presentation of new subject matter but rather in its lucid explanation of accepted facts. Of all the statements made there are very few which the modern physicist or chemist would question. It is easy reading that will entertain and leave a life impression even upon the unscientific mind.

The Theory of Relativity. By Erwin Freundlich. Translated by Henry L. Brose, with an introduction by Viscount Haldane. New York: E. P. Dutton and Company. 98 pages. $2.00.

DR. FREUNDLICH, the author of this book, is one of the younger astronomical adherents in Germany of the Einstein theory. In an earlier book on the "Foundation of Einstein's Theory of Gravitation," rendered into our language by the same translator, the author gained many adherents to his viewpoint and doubtless will add many more with this volume.

The text is composed of an introduction and three short lectures on (1) Newtonian Mechanics, (2) The Special Theory of Relativity, and (3) The General Theory of Relativity. For ten years now there has been a heated debate on the merits of Einstein's Theory with scientists pretty well divided on the subject. Much has been written but little seems convincing. One is somewhat reminded of the early experiments and theories on electricity and the flow of ions. It will be recalled scientists could not agree whether it was positive electrons that existed and that negative merely denoted their absence, or whether the negative were the real. Scientists first guessed the positive were the real, but later experiments have proven their earlier choice was wrong, and matter minus electrons is now said to be positively electrified. Similarly the theory of relativity hangs in the balance.

Dr. Freundlich makes no attempt to discard the Newtonian theory and admits it will never lose its great practical importance. His view is, however, that we must remain unprejudiced enough to recognize that it contains assumptions that apparently are not admissible in physics.

The lectures bring into prominence two fundamental features of relativity. The first of these is that there is a finite velocity which we are really compelled to presuppose is constant in observation, whatever may be our co-ordinates and whatever our system. The second feature brought out as of great importance is that of equality of inertial and gravitational energy. Thus gravitational effects in their final analysis are distinguishable only as states of acceleration. Obviously, a study as technical in nature as this must be based on endless experiments and investigations. Dr. Freundlich believes the results show that the Newtonian theory is faulty and, in the light of twentieth century physics, is obsolescent. It can be said for the author that the data submitted give a strong basis for his conclusion, but where physicists will disagree is in the accuracy of the data. Few are qualified to discuss the higher mathematics involved and few will be able to follow the line of reasoning without first going into the elementary phases of relativity.

The volume is a clear exposition of the affirmative and as such should not be omitted from the reading list of any investigator, be he pro or con. However, the book contains no unusual or world-convincing theories and leaves the reader still in doubt as to the validity of the Einstein theory.

The Life of Pasteur. By Réne Vallery-Radot. Translated from the French by Mrs. R. L. Devonshire. With an Introduction by Sir William Osler, Bart., M. D., F. R. S. New York: Doubleday, Page and Co. 1923. 484 pages. $3.00.

BORN at Dole, December, 1822, the son of a French tanner, Louis Pasteur became during the span of his long and useful life one of the greatest benefactors to humanity in the history of the world. His life is a sermon fraught with lessons of humility, constancy and perseverance; his work, taken as a whole, is a boon to mankind the true value of which will not be appraisable until the last of human kind has shuffled off this mortal coil.

Of his early studies in fermentations while dean of the faculty at Lille and of his earlier crystalographic researches little need be said here—their influence even in the remote field of ordnance are as far reaching as they are universally known and unanimously accepted. These, together with his marvelous work in the regions of spontaneous generation, silkworm disease, chicken cholera and hydrophobia, are golden pages in the history of human advancement. But this book is more than a chronicle of the discoveries that had such beneficent influence upon the sufferings of men, it is the narrative of the life and work of one of the greatest characters of all time, Pasteur, he whom an anonymous writer in the *Spectator* called "the most perfect man who has ever entered the Kingdom of Science."

This work is a complete life of the man—his studies, his character, his knowledge and his perseverance. Every important act of his life is recounted, so that one is doubly impressed, first by the achievements and then by the scientist by whom they were wrought.

Dr. Osler, who contributes the scholarly introduction, confesses to have read the book three or four times. Little wonder then that one who has drunk of its pleasing draft only once is so submerged in its story—not so much in the story as such, mind you (and M. Vallery-Radot has written a masterful biography) but in the man, Pasteur.

Here is a topic for contemplation, a scientist of the greatest magnitude who was ever the great-hearted, broad-visioned, religious man of whose like science today seems to feel a woeful need. Dr. Roux has said

of this volume, "L'oeuvre de Pasteur est admirable, elle montre son génie, mais il faut avoir vécu dans son intimité pour connaitre tout lo bonité de son coeur." We concur and recommend the book most highly.

The Art of Public Speaking. By Albert J. Beveridge. Boston: Houghton-Mifflin Company. 1924. 67 pages. $1.50.

"SPEAK only when you have something to say. Speak only what you believe to be true. Prepare thoroughly. Be clear. Stick to your subject. Be fair. Be brief." Thus in these seven maxims does former Senator Beveridge set forth the cardinal rules for the public speaker. That the author is eminently fitted to discuss this subject his own experience and oratorical powers will attest. He has handled his thesis—indeed, it is no more than a rambling essay—in a very captivating way.

To speak before an audience of some kind, some where, some how, is no longer the chance that comes once in a lifetime. It comes to all of us as certainly as taxes and autumn colds. And what a lowly creature the cry "Speech" can make of an otherwise perfectly composed and all-sufficient somebody! And then the pain and torture of the listeners as the speaker rambles from one airy nothing to another, interposing "As I said before" over and over again and making utterly futile attempts at wit and would-be sidelights as ancient as Ararat!

Here in this little book—only 67 pages, neatly bound—Senator Beveridge has prepared a worthwhile little lesson that can be studied, even memorized, by everyone who ever hopes, or fears, or just happens, to respond to a toast or sway a frenzied populace. Or if perchance—and the chance is not remote—the opportunity comes when one must express himself even before a limited audience of one's own friends and acquaintance here are logical suggestions and time-tried axioms that will be of great help to even the most adept speakers on all occasions.

Conditions of National Success. By Hugh Taylor. New York: D. Appleton and Company. 351 pages. Indexed.

FOREMOST in the minds of the leading students of law and government of today is the question of national success. We have witnessed a world war waged and lost by a power believed to be nationally successful and we have seen the high ideals expected as a result of that war rapidly disintegrating. It is, therefore, not to be wondered that the people of today are seeking diligently to find out, if they can, what the conditions of national success really are.

The author has attempted to point out to such inquirers what he considers the necessary conditions—conditions which he believes to be paradoxical. While the original idea was to trace through the nations the application of the principles discussed, this idea was abandoned since it was believed the length to which such discussions would extend made it inadvisable. It is believed that to the majority of readers this omission will be disappointing since the weakness of the book lies in the fact that it is not at all times convincing. Were there more applications and illustrations of the principles involved, the volume would become decidedly more impressive. Each of the seven chapters could easily be expanded into a fair sized book with proofs of the statements forming an important part of the text. On questions of vital importance the public wants more than a mere statement of the author's views. It demands convincing proof.

The author sees national success as an outcome of conflicting activities—each alone fatal to success but collectively ushering in a new era. Thus the coalition form of government is seen as a progressive step in government because the fusion of liberal and conservative ideas leads to sound principles where either would become dangerous if not checked by the other.

Advocates of the League of Nations will find new support for their cause since the writer believes the only hope of rescuing the world from impending ruin lies in the formation of a league whose potential strength would be so great that no nation or combination of nations would dare oppose it. Thus war would be prohibited. In this last connection the author deals extensively with America's war record and concludes that American psychology is not much different from that of any other nation and that America has always shown itself ready to engage in war when her interests are at stake.

The volume has its fascination. It contains a multitude of ideas both new and old and furnishes an abundance of material for discussion. However, at the present time it must be considered as setting forth opinions rather than facts.

Colloid Chemistry. By The Svedberg. American Chemical Society Monograph Series. New York: Chemical Catalog Company. 1924. 265 pages. $3.00.

THIS monograph, by an eminent authority on the subject, is based on a series of lectures given by the author in 1923 at the University of Wisconsin. It comprises a general survey of the development of colloid chemistry, with particular emphasis on recent developments, and especially on researches carried out in the author's own laboratory at Upsala.

The book is divided into four parts. In Part I, "The Formation of the Colloid Particle" by the various methods of dispersion and condensation is discussed. Part II, "The Colloid Particle as a Molecular Kinetic Unit," is a study of colloid particles from the point of view of the molecular kinetic theory and includes Brownian movements, the size, shape and structure of colloid particles, and a good description of the ultramicroscope and its applications. Part III, "The Colloid Particle as a Micell," discusses phenomena relative to the particle with its surrounding or absorbed atoms, molecules and ions, among these being adsorption, coagulation and gel formation, with other changes of structure. Part IV, "The Destruction of the Colloid Particle," covers only one-half page, and is inserted only to call attention to the lack of investigation of this subject and to suggest its importance in geological and biological problems. The thoroughness with which the author reviews and digests the literature of colloid chemistry is evidenced by the 319 references comprising a very complete bibliography of the subject from the earliest observations of Berzelius to the most recent investigations. A list of general text books on colloids, together with author and subject indexes, concludes the book.

A Short History of International Intercourse. By C. Delisle Burns. New York: The Oxford University Press. 1924. 155 pages. $1.75.

A CONCOMMITANT of the present day tendency for a world panacea is an effffort to enshrine our own state of civilization as the only worth while attainment of the human race. Laudable as this effort may be and true though it be in some respects, to say the least it is rather an egotistic attitude which does not rest upon a foundation of actual fact. To praise our own status at the expense of ages past is not after all an indication of our own success. To sing the praises of materialism by ridiculing religious impulse, to chant the advent of atheism at the expense of revealed truth—these are shortcomings that even the twentieth century is not quite big enough to outgrow or quite logical enough to refute. And in these respects Mr. Delisle is a serious offender.

With the end he seeks—the true implication of patriotism—all must concur. He is right in endeavoring to interpret history as a chronicle of peace and not war. Likewise, he must receive the concurrence of all right-thinking people when he says "The history of civilization is mainly a history of man's outlook and man's emotions, not of man's possessions."

All will agree, too, that the evils of our present economic system must eventually be eradicated and that instrumentalities of mutual assistance will soon be of service to the less fortunate all over the world. These are aims which international intercourse will accomplish, and these are conditions which this "Short History of International Intercourse" very ably sets out.

But our disagreement with the author arises from his narrow concept of things and people long since passed. For it is the childish mind that claims all credit and allows little for others. The Middle Ages were not wholly devoid of merit nor were the years of the Christian Era that preceded them. It may be that those whom Mr. Delisle classes as superstitious idolaters had a far more accurate concept of the important things of life than our super-developed intelligista of today. And were it not for these influences—superstitious mummery, Mr. Delisle might say—who can tell what our present status might have been and whether the light of science would have permeated to the depths it has today?

As a summing up of our commercial and economic relations this book is quite novel, but in that it minimizes the work of people and ages past in the evolution of world peace it lacks a depth of understanding that mars its worth seriously.

Aniline and Its Derivatives. By P. H. Groggins. 256 pages. New York: D. Van Nostrand Company. $4.00.

THIS work should be of much interest to anyone interested in the general subject of chemical engineering, including the student and teacher as well as the engineer and plant chemist. As the author states, "The technique in the production of aniline has been used as a vehicle for presenting to the reader the business of plant chemistry."

A brief historical discussion is given in the first chapter. Chapters II and III discuss the reactions involved and an outline of the manufacture of aniline. The title of Chapter III, "Survey of Processes for Manufacture," is misleading, as it covers mainly the details of 8 processes for the separation of aniline from the reducer charge, comparing cost data, efficiency, etc. Chapter V is a brief summary of the advantages of ferrous chloride over hydrochloric acid as a reducing agent, while the advantages of the use of high grade iron borings in the reduction process are discussed in Chapter VI. The discussion of the manufacture of nitrobenzene in Chapter VII should more logically be placed in an earlier chapter, preceding the manufacture of aniline. It comprises an excellent account of the Hough nitrator and its operation. The analysis of cost factors entering into the production of nitrobenzene and aniline in Chapter VIII, together with "The Chemist's Budget" are of particular interest, while Chapter IX contains valuable operating data under the head of "Thermal Factors." The next two chapters treat of Aniline Poisoning and Physical Constants of Pure Aniline. The author gives his own values for the true physical constants of aniline and describes the methods by which they were obtained. "General Chemical and Physical Data" (Chapter XII) gives details of tests and analysis of nitrobenzene and aniline, together with tabulated data and curves of vapor pressures, solubilities, specific gravity, distillation tests, etc. Six patented processes for aniline manufacture are briefly described in the next chapter. 83 pages (Chapter XIV) are devoted to aniline derivatives, rather than meager details of manufacture being given for all of the important intermediates, dyes, etc. A general discussion of the important subject of corrosion as a factor in chemical engineering processes comprises the final chapter, entitled, "The Action of Acids and Alkalis on Engineering Materials."

The book is attractively bound, well illustrated. It is somewhat of a surprise to note, in such an excellent piece of work, a considerable number of errors in grammar and construction.

Principles of Auditing. By Eric L. Kohler, M. A., C. P. A., and Paul W. Pettengill, C. P. A. New York: A. W. Shaw Company, 231 pages. $4.00.

BOTH authors of this treatise are members of the faculty of Northwestern University, School of Commerce, and have therefore in addition to the practical experience which they have attained in the business world, the advantage of close contact with the scholar and student. This is clearly evident in their development of this book, where the student viewpoint has not been lost—a mistake far too common in books of this nature. For it is the student rather than the experienced business man that turns to new ideas and puts them into operation. The established firm is too deeply committed to a fixed procedure to vary much therefrom.

At first glance one is impressed by the logical manner in which the subject is presented. After establishing the fact that auditing is a profession there is a chapter devoted to the scope and purpose of audits. This is followed by a discussion of the necessary details in starting an audit and the mechanics associated therewith. Then in their natural order follow chapters on resources, accounts receivable, inventories, assets and liabilities, reserves, profit and loss accounts, concluding with chapters on exhibits and an audit report.

Each of the chapters is well written and outlines clearly and logically the working procedure to be followed in determining the financial conditions and earnings of a business. It is also noteworthy that consid-

erable thought has been given to methods which an auditor may use in detecting errors of commission or omission or of the principle itself and there are offered excellent suggestions and advice on this subject.

In keeping with the present day policy of standardization in all fields the author strongly advocates uniform terminology. While this may not be noticed by the casual reader, nevertheless its importance cannot be over emphasized.

Concluding the book is a complete set of auditing papers (79 in number) and a 17-page audit report, as well as 207 review questions on auditing. The papers pertain to an actual audit and ilustrate the application of the authors' ideas to a chosen case.

The Earl of Hell. By Joseph Gray Kitchell. New York: The Century Co. 1924. $2.00.

IN this interesting book Mr. Kitchell presents fantastic —but fairly readable—fiction. It is a much heralded book and, unlike many stories for whom press representatives have prepared glowing tributes, it even surpassed some of the nice things that have been said about it.

For instance, *The New York Times* characterized it as "a popular scientific romance which possesses an amusing theme. Here is a theme upon which the imagination may play at will. The story is well organized. Under the protection of a fluent scientific exposition designed for mass consumption much of it is convincingly told. Major Kitchell has done very well. His romance has the merit of brevity and conciseness. It is simply told, the plot is well centralized and the reader's credulity, with regard to the theme, is not overstrained.

The Cincinnati Tribune likewise had this to say: "Since many of the preposterous tales of Jules Verne have proven to be more or less accurate prophesies it wouldn't be wise to go on record as having applied a similar term to Major Kitchell's story • • • • Gracefully avoiding the problem of possibility or improbability, one may say without much fear of contradiction that the Earl of Hell is not only a highly entertaining book but also a most exciting one. After his hero is safely embarked on his career of experimentation, the author gets into his stride as a first class story teller and stays there until the last line of the book."

As for ourselves we add this to what has already been said: The situations are well portrayed, although the author apparently encounters some difficulties in weaving that 'negative force of gravity' through the thread of the story. The characters are interesting human beings; what matters it that their conversations are a bit stilted—the book is good reading notwithstanding.

Industrial Hydrogen. By Hugh S. Taylor, D. Sc. (American Chemical Society Monograph Series.) 210 pages. The Chemical Catalog Company Inc. 1921. New York. $3.50.

THE rapidly increasing importance of hydrogen in various industrial applications justifies calling attention at this time to this excellent treatise on the subject. The book is apparently intended for the general reader rather than to serve as a text book for those engaged in the production of hydrogen. It emphasizes the chemical rather than the engineering side of the subject, although descriptions of plant equipment are sufficiently detailed to satisfy the average reader. The scope of the book is apparent from the chapter headings: Hydrogen from Steam and Iron; Hydrogen from Water Gas and Steam; Hydrogen from Water Gas by Liquefaction; Hydrogen from Electrolysis; Hydrogen from water; Hydrogen from Aqueous Alkalies; Hydrogen from Hydrocarbons; Miscellaneous and By-Product Hydrogen Processes; The Purification and Testing of Hydrogen. Each chapter is a general resume of its subject, written in concise and simple language, covering the general theory and development of the process as well as prospects for further development. The author has omitted any general or extended discussion of costs, but in every case gives data from which cost calculations can be made without difficulty. 218 references to patents and published articles are given throughout the text, showing a thorough knowledge of the literature of the subject on the part of the author.

The Influence of Temperature on the Explosibility of Ammonium Nitrate

(*Continued from page 602*)

temperature increases the rate of detonation and likewise the compression of the lead blocks.[8]

These tests give evidence that the rate of detonation of ammonium nitrate increases with the temperaure, and raches a maximum value at about 140° C.

Conclusions

1. The explosibility of amomnium nitrate increases with increase of temperature.

2. The temperature at which detonation is complete depends upon the booster used.

3. At 140° C. the ammonium nitrate tested was completely detonated when 25 grams of any one of the boosters (tetryl, picric acid, TNT, 80/20 amatol, 75/10 ammonium nitrate-nitroglycerin dynamite) was used; and the charge was confined in Shelby steel tubing having walls 1/16 inch thick, and the ammonium nitrate was confined at the normal shaking density 0.71. At this temperature, any of the boosters named were equally efficient in promoting detonation.

4. The relative efficiency of the boosters at temperatures varying from 10° to 140° C. fall in the following order placing the most efficient first—namely, tetryl, picric acid, TNT, 80/20 amatol, 75/10 ammonium nitrate-nitroglycerin dynamite.

5. There appears to be a critical point at a temperature somewhere between 120° and 140° C. for ammonium nitrate, above which any explosive used as a booster caused the ammonium nitrate to detonate completely.

Acknowledgements

In carrying out this investigation, the author acknowledges the assistance rendered by C. A. Taylor of the Explosives Chemical Section, in making analyses of the materials used in the tests; to J. E. Crawshaw, explosives engineer in charge of tests at the Explosives Experimental Station; to C. E. Munroe, chief explosives chemist for the Bureau of Mines; and to A. B. Coates and D. B. Gawthrop, assistant explosive engineers, for helpful suggestions.

[8] Further experiments on rate of detonation and effect of heat on rate of detonation have verified this. The results of these experiments will be the subject of the next paper.

Recent Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

THE following patents relating to Ordnance have been issued since the last issue of ARMY ORDNANCE:

Ammunition

CLARENCE I. B. HENNING, assignor to E. I. duPont de Nemours & Co., has been granted patent No. 1,503,530 for priming mixture for propellant explosives. This mixture contains as its principal ingredient trinitrobenzene.

Patent No. 1,503,632 has been granted to H. M. Brayton, of Picatinny Arsenal, for a safety plunger for artillery fuzes. The plunger carries a rotor normallly held in unarmed position, armed through centrifugal force.

A patent covering armor-piercing projectile, No. 1,503,739, has been granted to Geo. M. Ryan. The principal feature of this device is the provision of an armor-piercing drill in the nose of the shell.

Harry W. Klinger, assignor to Hercules Powder Co., has been granted patent No. 1,503,956, for an explosive and process of making same. This patent relates to a nitro-starch explosive of a highly stable character.

Heinrich Romberg, assignor to the firm of Rheinische Metallwaaren-Und Maschinenfabrik, has been granted patent No. 1,504,144, for a projectile. The main feature of this device is the provision of a propellant charge chamber in the base of the shell.

John W. Stockett, of the Office of Chief of Ordnance, has been granted patent No. 1,506,097, for ammunition for line throwing guns and the line carrying ring therefor. The feature of this invention of particular interest is the provision of an inflammable propellant charge container attached to the base of the projectile.

Patent No. 1,506,785 has been granted to E. A. Sperry for a gravity bomb. This bomb is provided with a drag rudder and with means for releasing the explosive portion of the bomb from the retarding effect of the drag rudder when desired and for illuminating the target.

John H. Goss, assignor to Scovill Manufacturing Company, has been granted patent No. 1,508,450 for a fuze for projectiles. The inventor contends that in time fuzes of the powder train type, with the fuze cap locked, the rings set back on discharge causing a gap between the rings and cap through which the gases of combustion will vent instead of through the spaces between the rings, thus destroying the accuracy of the fuze. To overcome this, he has provided an unlocked cap which is free to screw down by means of the rotary movement of the shell on discharge and thus close any space between the cap and rings.

Maj. J. H. Woodberry has been granted Patent No. 1,509,328, for a fuze for projectiles. This is a delay action fuze in which the striker spring is normally uncompressed but is compressed on set-back and held in such compressed position until the shell reaches its target.

Maj. J. H. Woodberry has also been granted patent No. 1,509,329, for a fuze. This is a delay action fuze in which the firing elements are normally spaced apart, one of the elements carrying a detonator, normally remote from the main explosive charge, both elements adapted to move in the same direction on impact and one of the elements spring impelled in an opposite direction after impact with means for delaying such spring action.

Leon O. Bryan, assignor to E. I. duPont de Nemours & Company, has been granted patent No. 1,509,393 for an ammonium nitrate explosive. This invention is designed to use propellant powders in mixture for the purpose of producing blast explosives.

John Marshall, assignor to E. I. duPont de Nemours & Co., has been granted patent No. 1,509,367 for a high explosive. This invention is also designed to produce mixtures which will permit the use of propellant powder in producing blasting explosives.

Patent No. 1,509,935 has been granted to William N. Dehn for an explosive and the process for its manufacture. The patent covers an explosive mixture containing sodium nitrate and plant tissue impregnated with ammonium nitrate.

Fred Olsen, Picatinny Arsenal, has been granted patent No. 1,510,555 for a detonating or disruptive explosive. The object of this invention is to make use of a propellant powder in forming a suitable mixture for a disruptive or blasting explosive.

Patent No. 1,511,771 has been granted to Hans Rathsburg for an explosive compound for primer and detonator. The combination disclosed by this patent contains a salt of tetrazole or its derivatives.

Artillery

B. P. JOYCE of Rock Island Arsenal has been granted patent No. 1,503,589 for a counterpoise. The counterpoise acts through a crank arm fast on the trunnion and means are provided for varying the length of the crank arm to compensate for different positions of the gun.

Otto Eppenstein, assignor to the firm of Carl Zweiss, has been granted patent No. 1,503,752 for a telemeter. In this telemeter each detachable collective lens is placed

in front of the ocular prism system instead of to the rear thereof as is customary.

Patent No. 1,505,083 has been granted to Robt. S. Blair for a gun sighting mechanism. The device covered by this invention has gear trains actuated by foot pedals which may be used in pointing or training the gun.

Heinrich Erfle, assignor to the firm of Carl Zweiss, has been granted patent No. 1,505,878 for a telescope.

Walther Akemann, assignor to Fried Krupp, has been granted patent No. 1,505,935, for an apparatus for determining a magnitude which varies with the time. This apparatus is especially useful in determining the range of a moving target.

Rudolph Forster, assignor to Fried Krupp, has been granted patent No. 1,506,625 for an electric long distance control. The apparatus is designed for the transmission of rotary movement of the transmitter to the receiver acting synchronously therewith.

Henry J. Stambaugh and George M. McCann, assignor to United States Ordnance Company, have been granted patent No. 1,507,443 for a breach mechanism. The object of the invention is to provide means for imparting a motion of translation to the breech plug during rotation thereof.

Small Arms

PATENT No. 1,503,568 has been granted to Geo. Walther for an automatic pistol. In this structure the cock is made ready on recoil of the breech block but is moved out of position and held in such position by the main spring until the butt of the pistol is gripped with the hand when the same is moved back to position and may then be released by a pull on the trigger.

Patent for a disappearing bayonet, No. 1,504,073, has been granted to S. L. Moore, assignor of one-half to Ed. Montgomery. In this structure a sheath is fastened at the side of the rifle barrel in which a bayonet is normally housed for extruding by means of a coil spring when a lock is released.

Harry A. Sutton and Alfred E. Verville have been granted patent No. 1,504,393 for a cartridge feeding mechanism for automatic guns. The main purpose of the structure is to provide a cartridge feeding mechanism for guns using a heavy caliber cartridge.

Herbert O. Russell and Charles L. Paulus, of McCook Field, have been granted patent No. 1,504,714 for a machine gun and a hopper feed box therefor. The structure covered by the patent is designed to produce a feed box adapted to be removably attached to a flexibly mounted machine gun for feeding loose cartridges to the gun.

H. O. Russell and C. L. Paulus, of McCook Field, have been granted patent No. 1,504,717 for an automatic cocking attachment for machine guns. The structure covered by this patent provides a mechanism for automatically recocking the gun upon failure to fire.

Patent No. 1,505,956 has been granted to Alfred H. Hofer for a detachable target butt plate. The invention covers a butt plate designed to be quickly attached to and detached from the ordinary butt plate of the regulation Springfield rifle.

Maj. John G. Winter has been granted patent No. 1,507,223 for a sighting drill system and device.

Vid Zugaja has been granted patent No. 1,507,411, for a pistol. The invention covered by this patent resides in the provision of a lock which may be readily unlocked to permit breaking of the pistol barrel for the insertion of a cartridge therein. The lock is formed on the trigger guard and holds the barrel in normal position when the trigger guard is swung to its normal position.

Capt. Walter T. Gorton has been granted patent No. 1,509,401 for a receiver for machine guns. The object of the invention covered by this patent is the provision of a receiver so constructed as to withstand all the usual shocks incident to machine gun use.

John M. Browning has been granted patent No. 1,511,262 for an automatic firearm. The invention covered by this patent has for its object the production of a machine gun or automatic firearm in which all operations of the mechanism, except that of the trigger, are automatically effected and also the provision of means for regulating or retarding the rate of fire while retaining the automatic action.

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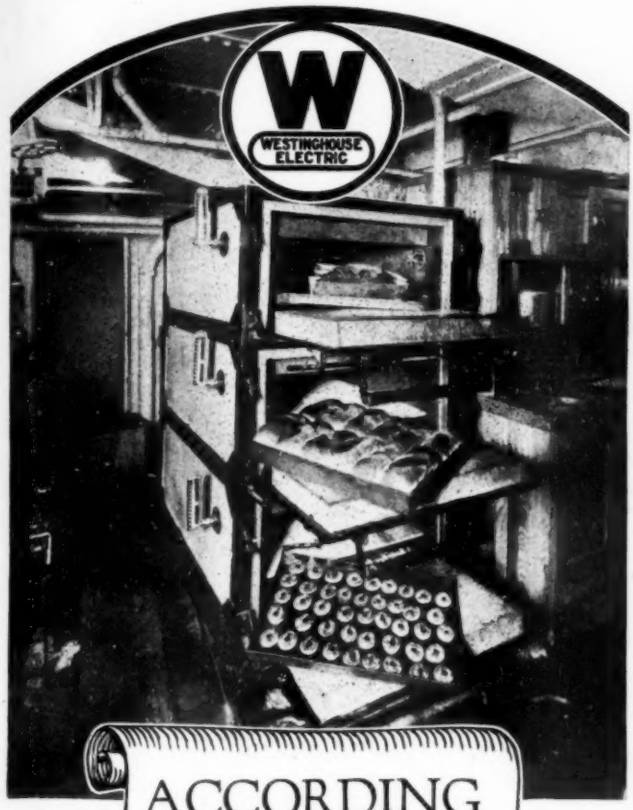

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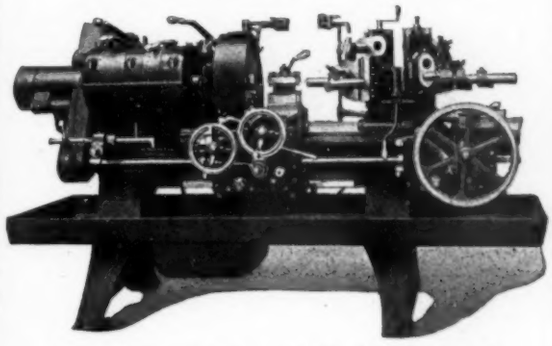

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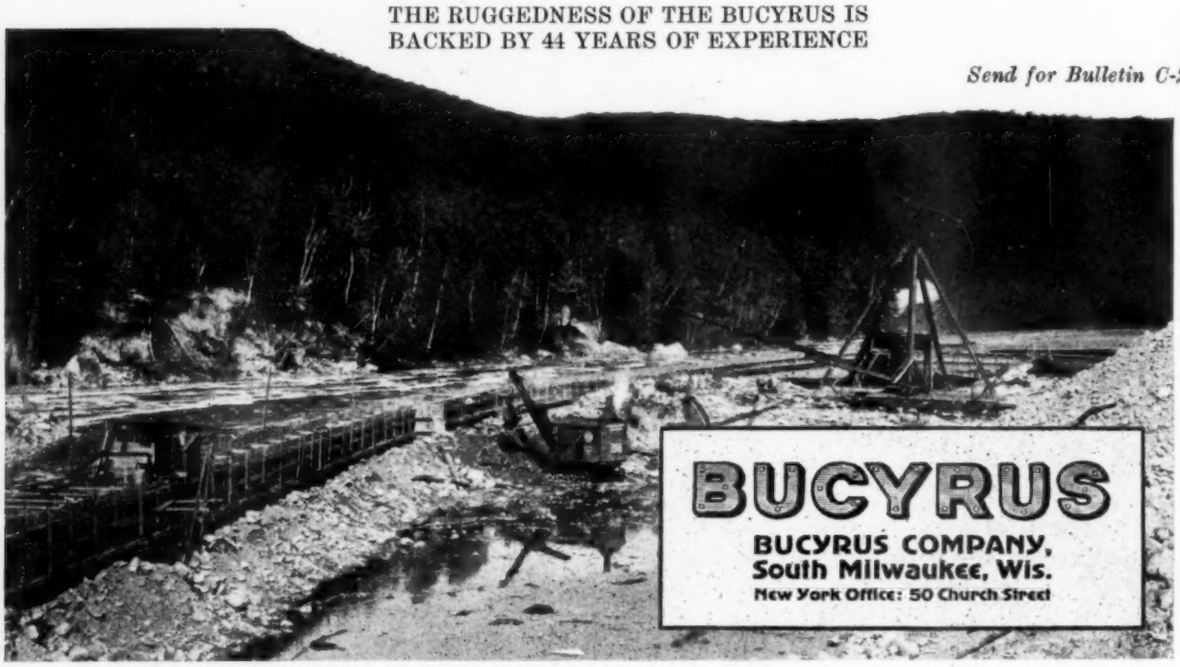

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